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October 12, 1933

Engineering News-Record

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Cities Need More Engineers

ONE of the obstacles to getting municipal PWA projects ready lies in inadequate and overworked engineering staffs. This fact is evident from the countrywide survey reported last week. The situation requires remedy, for present disorganized and decimated technical staffs cannot prepare plans fast enough to meet the demands of the Recovery Act. The shower of PWA applications returned by the examining engineers marked "insufficient plans" is proof enough that more adequate technical help and advice is needed in nearly every town and city. Only by employing engineers now can workmen be given jobs a month from now.

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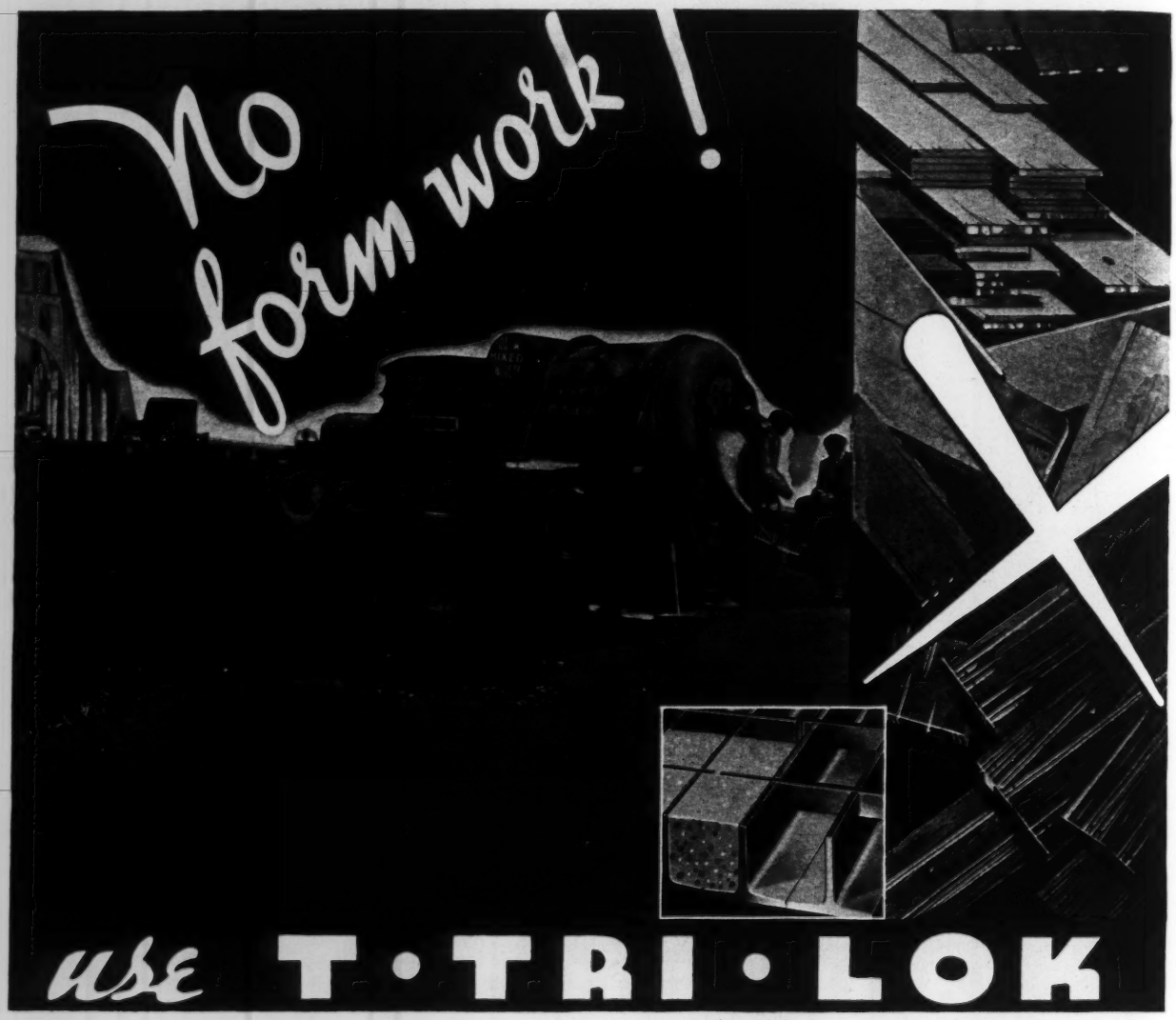

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Selecting Pumping Equipment for a Large Water Plant

First of two articles outlining the studies made in connection with the new Detroit water supply, which involved a careful comparison of three types of pumping equipment—Motor-driven centrifugal pumps selected, with power generated at the plant

By William C. Rudd
Assistant Engineer of Power, Department of Water Supply, Detroit, Mich.

and Louis E. Ayres
Consulting Engineer, Ayres, Lewis, Norris and May, Ann Arbor, Mich.

CONFRONTED with a marked increase in water consumption in the decade beginning 1910, the board of water commissioners of the city of Detroit directed its attention, from 1919 to 1924, to the preparation of a plan for an additional water supply. During this period five reports were received, three from consulting engineers, one from the general manager and one from a consulting board. These reports covered every feasible source of supply: one consultant dealt with Lake Huron, two with Lake St. Clair, and the general manager, after reviewing all previous studies, recommended the Detroit River as the source for an additional supply. The consulting board concurred in the latter recommendation, and its report was approved by the board of water commissioners on Jan. 8, 1924.

In 1925 a new division of engineering of the Department of Water Supply was organized for the purpose of carrying out the recommended project; and this division, under the direction of George H. Fenkell as chief engineer, was engaged for about seven years in the design and construction of a new intake, over 11 miles of tunnel varying from 15½ to 12 ft. in diameter, and on the construction of the Springwells filtration and pumping plant. This work, now substantially completed, represents an investment to date of about $23,500,000, exclusive of a large expenditure in trunk-line water mains. It provides, together with previously existing plant, a water supply sufficient for the requirements of a population of more than 3,000,000.

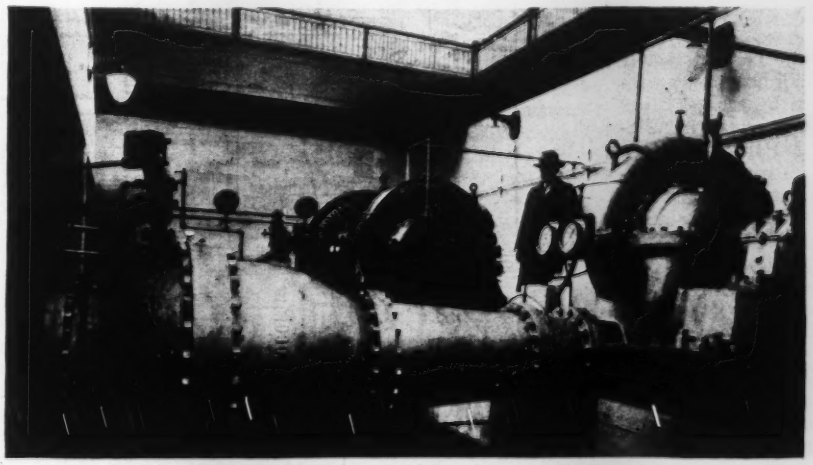


Fig. 1—Horizontal motor-driven centrifugal pumps were selected for high-lift service. Eight rectangular pump pits are provided in the high-lift station, each of which is to contain two pumping units.

So much for the general picture.

A profile of the entire project is

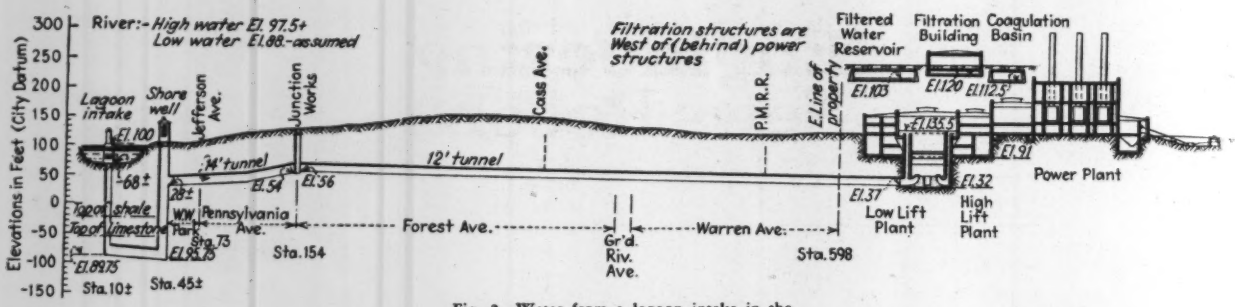


Fig. 2—Water from a lagoon intake in the Detroit River flows through a concrete tunnel more than 11 miles long to the new waterworks plant at the western boundary of the city.

shown in Fig. 2. A discussion of the design and construction features of the low-lift plant—a 90-ft. circular structure, 110 ft. deep—appeared in *Engineering News-Record*, March 19, 1931; and a description of the lagoon intake was published in the issue of Sept. 24, 1931.

This article aims to present some of the interesting aspects of studies that were made concerning types of waterworks pumping equipment, with particular reference to relative costs under Detroit conditions.

Factors Considered — The types of equipment considered in these studies were: plunger pumps driven by triple-expansion engines; and centrifugal pumps driven by: *(a)* steam turbines; *(b)* electric motors, both a.c. and d.c. and constant and variable speed; and *(c)* water turbines in case of the low-lift station.

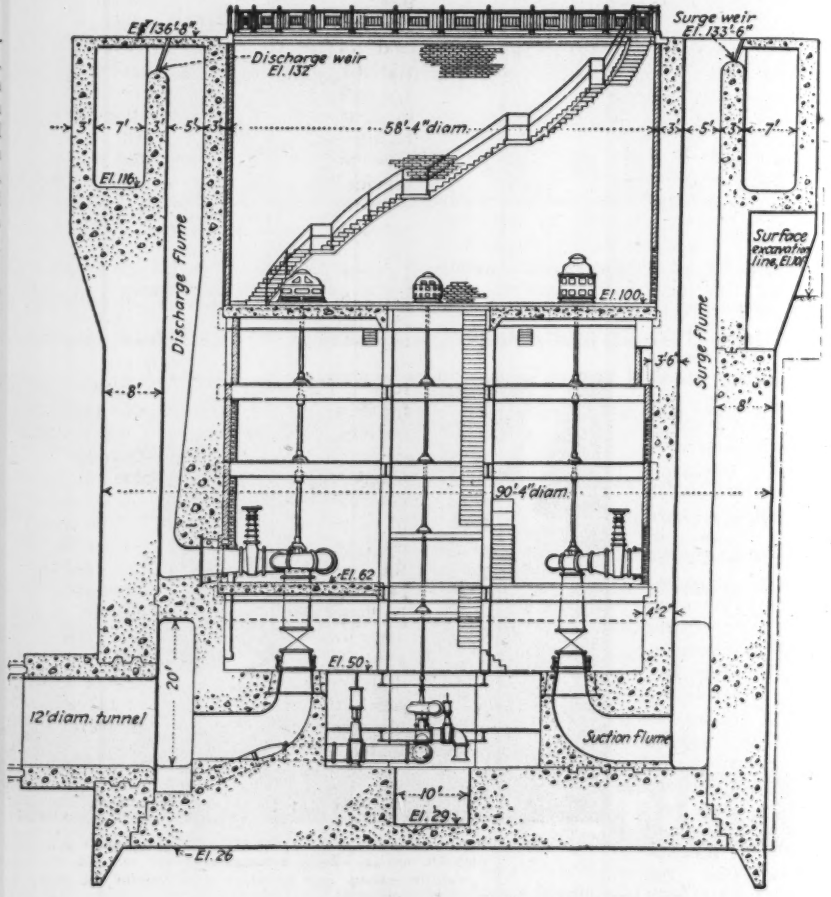
Three factors were kept in mind—namely, adaptability, reliability and cost. Under adaptability, account was taken of the relative ease and economy with which considerable variations in load and head, arising out of changes in water consumption, daily throughout a year and over a period of years, could be met. Under reliability, such matters were weighed as: *(a)* plant location, whether near to or remote from reliable sources of power; and *(b)* pump setting, whether at or near ground surface, or in deep pits. Cost became a determining factor only when other essential requirements had been satisfactorily met.

Precedents—Prior to 1923 all water pumping in Detroit had been done with plunger pumps, driven by reciprocating steam engines. The original installation at Water Works Park, consisting of one compound pump having a capacity of 24 m.g.d., was put into service on Dec. 15, 1877. A second and similar pump was installed in 1880, and a third of like type, having a capacity of 30 m.g.d., was installed in 1886. Then, during the following 29 years, ten triple-expansion engines, having capacities of 25 to 37 m.g.d., were installed; so that, at the time of the beginning of the studies and reports of 1920 to 1924, there were in service and contemplated a total capacity, in pumping engines, of 378 m.g.d.

In 1923 a low-lift pumping station, in connection with the new Water Works Park filtration plant, went into operation, containing entirely motor-driven centrifugals. Then, on Jan. 5, 1924, the consulting board recommended that two of the reciprocating pumping engines "be immediately replaced by motor-driven centrifugal pumps of 140-m.g. combined daily capacity." This replacement was effected by 1926, and in 1928 another engine was replaced by a 40-m.g.d. motor-driven centrifugal; later an additional 40-m.g.d. unit was installed. With these changes accomplished, motor-driven centrifugals made up 40 per cent of the total capacity of 500 m.g.d. which is represented by the pumps at the two Water Works Park pumping stations.

It is of interest to note that, although the policy of the water department up until 1924 was to distribute water with triple-expansion engines, since that time all new units, including all of the new Springwells plant, have been motor-driven centrifugals. The reasons that led to this type of equipment at Springwells, however, were not the same as those that were deciding factors at

Fig. 3—The substructure of the low-lift pumping plant is circular in plan, to withstand the terrific soil pressures encountered. The suction chamber for the pumps is an annular space between the structure's outer shell and an inner circular wall. Discharge flumes and surge flumes extend up to a similar discharge channel above. To eliminate danger of accidental flooding, the motor floor is above the level of the river.



Water Works Park. In the latter case the rapidly increasing demand for water and the space requirements in the existing buildings practically forced the adoption of the motor-driven type of pump. With both high-service pumping stations filled with equipment in 1924, it was possible, by replacing three old compound engines with motor-driven centrifugals, to increase the total plant capacity from 378 to 500 m.g.d. without requiring additional building space. It should be added, on the score of reliability, that these motor-driven units were to receive their supply of energy through duplicate services, one from the Public Lighting Commission, a municipal utility, and the other from the Detroit Edison Co.; and that other conditions were such as to assure a relatively high degree of reliability in the service.

Early Recommendations—In general, it may be said that the several consultants recommended steam-turbine-driven centrifugals for service pumping (i.e., pumping into the distribution system) and motor-driven centrifugals for low-lift pumping, supplying filter plants and in connection with clear-water reservoirs.

In the Lake Huron project, which contemplated a 400-m.g.d., 375-ft.-head pumping station, located near the lower end of Lake Huron, the late Gardner S. Williams proposed a steam generating plant in connection with a pumping plant, the latter to contain "centrifugal units," presumably driven through reduction gears by steam turbines. Such a proposal clearly indicated a major emphasis on reliability, inasmuch as this pumping plant was to deliver its output into a 2-billion-gallon storage reservoir, whence the supply could flow by gravity to another reservoir on the outskirts of Detroit, and the plant location was within about seven miles of a large central station. With duplicate transmission lines from the central station readily obtainable, with several days' consumption of stored water available and with sudden load fluctuations eliminated by the reservoir, the conditions would appear to be ideal for the use of centrifugal pumps driven by synchronous motors. Yet this engineer favored, obviously because of greater reliability, a complete and self-contained station rather than a less costly one that was dependent on outside power.

Of the two reports submitted proposing Lake St. Clair as a source of supply, one emphasized dependability as the chief element to be considered in deciding the type of equipment, and the other was influenced by such elements as ease with which coal could be delivered and flexibility to meet hourly variations in water consumption and cost. In one report, which contemplated a filter plant on an artificial island in Lake St. Clair, motor-driven centrifugals were proposed on the island because "even in the event of a temporary but complete failure of the electric current" water could still be "delivered to the steam-driven pumps at Northeast Station by gravity flow alone." All other pumping in the two inland stations was to be done by steam-driven pumps, with turbine-driven centrifugals recommended. The other report, which contemplated a Lake St. Clair supply through an intake crib and an inland filtration plant, proposed in the way of equipment: *(a)* motor-operated centrifugal pumps at the filtration plant "because of its more remote location . . . in order to eliminate the necessity for large and constant deliveries of coal"; and *(b)* at the North and West stations, "where the high-service pumpage will fluctuate at all times to conform to hourly rates of consumption, steam-turbine driven pumps, in order to provide that flexibility essential to such service."

In the report of the general manager, submitted in September, 1923, and recommending as a source of supply the Detroit River near the head of Belle Isle, there were presented in considerable detail the construction and operating costs involved in pumping stations containing: *(a)* motor-driven centrifugals, *(b)* steam-turbine-driven centrifugals and *(c)* triple-expansion pumping engines. The conclusions as to cost were that "under Detroit conditions, where the hourly peak, plus adequate reserves, require an installed capacity of twice the average load . . . the cheapest type is the motor-driven centrifugal, the next best the steam-turbine-driven centrifugal, and the most expensive the triple-expansion pumping engine." And assuming a plant having a machinery capacity of 400 m.g.d. and an average delivery of 200 m.g.d., against a 150-ft. head, the investment and total annual charges of the three types were estimated as follows:

Type	Investment	Total Annual Charges
Triple-expansion engines	$4,680,000	$726,150
Steam-turbine-driven centrifugals	2,800,000	670,920
Motor-driven centrifugals	880,000	635,230

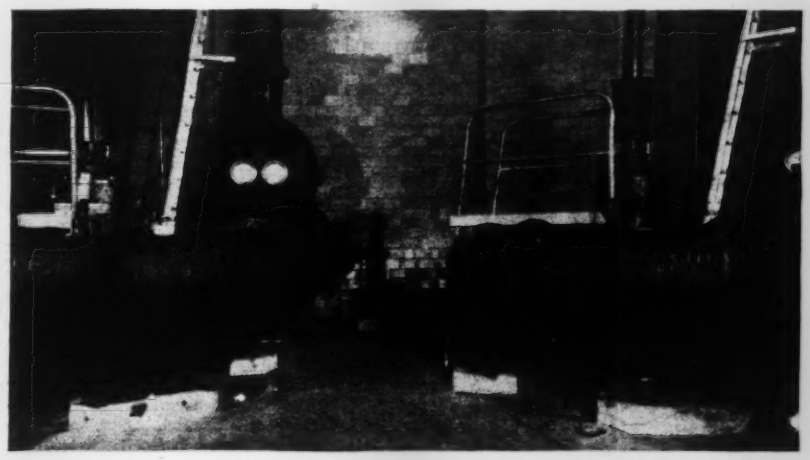


Fig. 3—Eight low-lift pumps are provided, driven by vertical motors located on a motor floor 38 ft. above.

Considering the element of reliability, the report stated that, "If motors are supplied with electric energy over transmission lines, there are bound to be interruptions in the supply of current due to storm or other causes which would shut down the station. This is a condition not to be permitted in a direct-pressure system. If the electrical energy is generated at the site, the element of unreliability is largely eliminated, but current produced in a comparatively small station would cost more than in the large power station of the Public Lighting Commission, and the apparent financial advantage of motor-driven centrifugals would probably disappear. In low service, however, the element of reliability is not so important, as the pumps operate behind reservoirs containing excess capacity for such an emergency, and a failure of electric energy up to one hour can be tolerated." The recommendation was that for high-service pumping, steam-turbine-driven centrifugals and low-service pumping, motor-driven centrifugals be adopted for estimating purposes, but that the final decision should be based on detail plans and bids from machinery manufacturers.

Finally, the report of the consulting engineering board of Jan. 5, 1924, made the following recommendation regarding pumping equipment: "The pumping machinery at the new stations should be centrifugal in type, and the pumps for both high and low service should be steam-turbine-driven."

Early Springwells Studies—The new division of engineering, organized in 1925, proceeded with its early studies in accordance with the instructions of the consulting board. Various general layouts were made, including the high-lift and low-lift pumping plants and the power plant, all premised on the use of steam-turbine-driven centrifugal pumps.

One of the early and difficult prob-

lems was the determination of a proper design for the low-lift plant. The raw water was to reach this plant through a 12-ft. tunnel having its invert more than 80 ft. below the ground surface at the site. Borings indicated a soft clay down to a depth of 73 ft., with hardpan at a depth of 75 ft. The general character of the soil and the construction problems involved were later to be presented to the bidders as follows:

> Particular attention of the bidder is directed to the nature of the soil in which the work is to be executed. According to the best information, the clays are soft, difficult to handle and will exert heavy loads. At about hardpan, water-bearing strata will be encountered which may contain gas . . .
>
> An important feature that should not be overlooked by the bidder is the fact that, due to switching operations on the right-of-way of the Detroit Terminal Railroad, a vibration is set up at times in the soil at the site of the plant. This condition might precipitate a slide or movement in the soil.

The requirements as to depth together with the soil conditions made it desirable to keep the size of the station to a minimum, and led naturally to a circular structure as being best adapted to resist the probable loads.

Another important element in the design was water surge. This station was to operate at the lower end of more than 11 miles of large-diameter tunnel, and provision must be made, in case of sudden shut-down, to absorb the kinetic energy of 210,000 tons of water moving with a velocity of 6½ ft. per second.

The first plant layouts were circular structures containing eight steam-turbine-driven centrifugal pumps and incorporating a 25-ft.-diameter surge tank from which the pumps took their suction. This arrangement called for an outside diameter of 140 ft., a depth of substructure below finished grade of 100 ft., of pumps and steam turbines set 65 ft. below grade and about 30 ft. below Detroit River level, at a total cost of over $2,000,000. These first layouts, therefore, were not satisfactory. The construction problems were unprecedented, the absolute operating reliability open to some question, and the cost excessive. The relatively large size for the plant was the result of: *(a)* the use of horizontal centrifugal pumps driven by steam turbines, through reduction gears; and *(b)* the incorporation of a surge tank within the structure.

This situation led to two distinct studies involving: *(a)* the relative costs of steam-turbine-driven, as against electric-motor-driven, pumps and, in addition for the low-lift plant, the consideration of a water-turbine drive; and *(b)* an investigation into all the elements affecting design, construction and operation of the low-lift plant. These studies, carried on during 1926 and 1927, culminated in certain reports which finally determined the design.

Relative Costs—The first of the above-mentioned studies—namely, the one on relative construction and operating costs—was made by the bureau of power of the Department of Water Supply in cooperation with the engineering department of the Detroit Edison Co.

At the outset, the following types of drive, for centrifugal pumps, were considered:

1. Steam turbines with helical reduction gears.
2. Variable-speed electric motors, with:
   (a) A combination of constant and variable speed types and
   (b) the slip-ring type.
3. Constant-speed electric motors, with
   (a) the synchronous type, and
   (b) the squirrel-cage type.

The first studies of the Detroit Edison Co. engineering department, submitted on Oct. 25, 1926, concluded:

> 1. The total investment required for each type of motor drive is less than for turbine drive.
>
> 2. The annual costs for fuel, maintenance and payroll is less for motor drive than for steam-turbine drive.
>
> 3. The reliability afforded by motor drive is at least equal to that of turbine drive. This conclusion was premised on the installation on the site of turbo-generators having a capacity equal to the maximum hour and a standby transformer installation equal to the difference between total connected load and maximum hour, and also equal to the caacity of one turbo-generator, to permit shutting down for overhaul.
>
> 4. Capacity and head regulation adequate for conditions of minimum, average and maximum demand can be obtained by providing one or two variable-speed slip-ring motors in each service.

The studies of the water department engineers, however, submitted on Nov. 20, 1926, presented comparative estimates of a steam-turbine-driven and a motor-driven plant and showed the former to be somewhat less than the latter in construction costs but somewhat more in operating charges; and concluded that they did not believe "that there is enough difference in the first cost or in operating cost of either of the two types of plants to make either one . . . better than the other."

Then, following numerous conferences, the Detroit Edison Co. engineers submitted a revised report on June 15, 1927, in which the schemes considered had been reduced to three and, arranged in the order of either total investment required or operating costs, were as follows:

1. a.c. motor drive for all main pumping units, embodying a combination of constant-speed synchronous and variable-speed slip-ring motors, and
2. Steam-turbine drive for all high-lift pumps and d.c. motor drive for all low-lift pumps, and
3. Steam-turbine drive throughout.

A final comparison of the several studies and a tabulation of the estimates were presented to the board of water commissioners on Sept. 27, 1927. This presentation covered these three schemes and in addition a fourth scheme contemplating steam-turbine-driven centrifugal pumps in the high-lift plant and water-turbine-driven centrifugal pumps in the low-lift plant.

The comparative estimates are summarized in the table following. The figures, although comparable, are not complete: *they do not include those costs common to all schemes.* For example, whereas the estimates in the table covering the plan of "Electric Motors Throughout" is shown as a maximum of $2,316,560, the expenditures to date under this plan, which was the one built, have amounted to nearly $6,500,000. Also, the difference in construction costs in the plan for "Steam Turbines Throughout," as estimated by the two engineering departments, arises mainly out of different structural designs used in the low-lift plant. The figures are as shown in the table below.

Low-Lift Plant Studies — Studies carried out by the water department engineers, aided by a consultant, were embodied in a report which contained sketches and cost estimates covering 21 different schemes, all involving centrifugal pumps, as follows: nine designs with vertical-motor-driven pumps in a circular plant; four designs with horizontal-motor-driven and three designs with horizontal-turbine-driven pumps in a circular plant; three designs of rectangular plants with both horizontal motor and turbine drive; and two special designs of cellular structures built up of independent shafts, each shaft containing a vertical-motor-driven unit. This report reviewed the problems involved in the several designs from the standpoints of construction difficulties, surge adequacy, operating reliability and cost.

The portion of this report, particularly pertinent to this article, deals with "the relative reliability of the two prac-

COMPARATIVE COST ESTIMATES OF PUMPING STATIONS AND EQUIPMENT

Plan	Detroit Edison Co.		Water Department	
	Construction Cost	Annual Operating Cost	Construction Cost	Annual Operating Cost
Steam turbines throughout	$2,692,475	$667,520	$2,319,050	$619,630
Electric motors throughout	2,167,955	578,760	2,316,560	588,160
Steam turbines in high-lift and water turbines in low-lift			2,559,360	662,110
Steam turbines in high-lift and d.c. motors in low-lift	2,527,945	649,030	2,537,050	638,470

ticable kinds of motive power—namely, steam and electricity." On account of cost, water turbines had been eliminated from consideration. The principal comments on the use of steam were that, as the turbines must be placed about 70 ft. below finished grade, long vertical feeder mains would be required, 8 in. in diameter and carrying 300 lb. of pressure at the throttle; that the support of these mains introduced unusual structural problems and that stresses arising out of pipe movement might result in joint failure; and although it is perhaps practicable to supply automatic-control equipment for the prompt closure of a broken header, the break of a main in a station so far below ground might result in serious injury or death to employees. As to the high-speed turbine, an accident, resulting in a broken turbine casing, was thought a possibility, and an experience of this sort at Indianapolis, Ind., in 1927, was cited. Finally, the steam-turbine installation would be subject to the possibility of flooding from water in the event of a broken pump casing; and an experience in Flint, Mich., on Dec. 4, 1927, was cited in which the steam turbines of the pumping station were completely submerged, due to a broken water main.

Discussing the reliability of electric motors, the report states that: "Assuming motors placed out of the reach of flooding, the chances for interruption of service . . . are limited to the failure of the motors themselves or the failure of the source of supply." The duplication of units was proposed to provide for the first contingency, and duplicate underground feeders from an immediately adjacent power plant and from an auxiliary and independent source of power, for the second. The contingency of flooded motors was eliminated by the use of vertical units, with the motor floor placed above the level of the Detroit River. In the plant, as built, flooding of any sort has been reduced to the possibility of a broken pump casing, as the surge chambers are incorporated in the outside walls of the structure, and the pumps discharge up through vertical concrete conduits, also in the walls, in lieu of inside iron pipes.

Motors Adopted Throughout—On the basis, therefore, of a lower cost in the plant as a whole, as appears from the table in the preceding section, and of greater reliability in the low-lift plant, motor equipment throughout, with an adjoining steam generating plant, was adopted for the Springwells station. Formal approval of the type was given by the board of water commissioners on July 11, 1928.

The Power Plant—Although a complete discussion of the several problems considered in connection with the steam and electrical equipment is beyond the scope of these articles, a brief summary of the adopted equipment and design bases seems desirable.

The steam-operated turbo-generator plant, which will have an ultimate capacity of 27,000 kw. in four 5,000-kw. main units and four 500-kw. auxiliary units, has now installed 16,500 kw. in two main and three auxiliary units. One 5,000-kw. transformer is also in place. Steam for the operation of the turbines is furnished by two 1,000-hp. water tube boilers; the ultimate installation calls for two additional similar boilers. Each boiler will have a maximum capacity of 90,000 lb. of steam per hour at 360 lb. per sq.in. gage pressure, with total temperature of 715 deg. F. Each boiler is equipped with superheater, economizer and air preheater and underfeed stoker. The fuel to be used is coal burned on underfeed stokers, operated on forced and induced draft. The power-plant auxiliaries are driven by variable-speed direct-current motors.

The electrical switching equipment for the motors of the pumps and generators is housed in a building between the pumping plant and turbine house. This equipment was purchased on a separate contract after the motors and generators had been secured. Engineering studies were made as to the relative advantages of 4,600-volt alternating current as against 2,300 volts, and because of greater economy 4,600 volts was adopted. Similarly, after a study, a 440-volt system was adopted in preference to 220 volts for the auxiliary motors. The switch gear used is the metal-clad type for the 4,600-volt system and steel cubicle type for the 440-volt system. All the oil circuit breakers are operated by d.c. solenoids, push-button, remote-control type. Direct current at 250 volts is used to drive the power-plant auxiliaries, and this power is generated in three 400-kw. motor-generator sets, operating on the 440-volt alternating-current system. The excitation power for the synchronous pump motors is secured from three 50-kw. motor-generator sets, having 440-volt a.c. motors and 220-volt d.c. generators. The synchronous motors driving the main pumps are started through reactors, which require the use of two oil circuit breakers. This design was found to be the most economical of the several plans considered. The slip-ring motors driving the main pumps are designed for a speed variation of 80 to 100 per cent in four steps, which permits a pump capacity variation of 50 per cent. The speed of the variable-speed pumps is controlled from the switchboard.

The switchboard for the pumping plant is located on the second floor of the switch house and overlooks the pump floor. It is of steel construction, has 94 panels and contains all the necessary electrical and hydraulic instruments for the proper operation of the pumping plant. The operator at this switchboard controls all of the pumps in the pumping plant. There is a similar switchboard, also on the second floor of the switch house but overlooking the turbine house, for the control of the equipment in the turbine house.

The second part of this analysis, which deals with the determination of heads and capacities for the individual pumping units, will appear in our next issue.—EDITOR.

Formula Developed for Determining Canal Seepage Losses

By Samuel Shulits
Hydraulic Engineer, Cambridge, Mass.

IT IS becoming good practice in Europe to use conformal transformation and flow nets in the study of seepage problems. This procedure is long and tedious, however, and R. Dachler in a bulletin of the Hydrological Institute of the Vienna Technical University attempts to simplify the computation by giving approximate formulas based on the method of conformal transformation.

The findings contained in the bulletin are summarized by Mr. Dachler in *Die Wasserwirtschaft,* March 25, 1933, p. 110.

The shape of the stream lines for the case of seepage from trapezoidal canals was investigated in the laboratory. Only the condition of steady seepage after the pores of the soil have filled with water was considered. The soil through which the canal passes, down to the impervious stratum, was assumed to be homogeneous and hence of constant permeability throughout. The canal was assumed to be neither naturally nor artificially sealed. It was also assumed that the distribution of seepage through the soil is symmetrical to the canal axis, so that one-half of the cross-section alone need be investigated; and that the elevation of the surface of the groundwater stream at a certain distance from the canal axis is shown. The experimentation dealt with deep and narrow canals at large and small distances above the impervious stratum.

It was found that the flow nets or stream-line diagrams could be divided into two fields, to one of which the Darcy formula is applicable, while for the other a simple formula is set up. The latter formula contains a so-called form factor ϵ, the value of which is dependent on the shape of the cross-section and its position in the flow field near the canal. A chart is given with the values of ϵ for various dimensions and positions of the canal. The values of ϵ were determined by evaluating a large number of flow nets derived by conformal transformation and were checked with models.

With the aid of the given formulas and the ϵ-chart, the engineer can compute the seepage from a trapezoidal canal for the conditions stated in the third paragraph.

Improving Concrete Quality By Paying Bonuses

Bonus paid for excess strength and pay for extra precautions in winter concreting provide better concrete and fair compensation to contractors on group of sewerage structures

By M. H. Klegerman
Assistant Engineer, Alexander Potter, Consulting Engineer, New York, N. Y.

THE JOINT MEETING, a body formed to provide sewerage for a group of eleven municipalities in northern New Jersey, has employed through its chief engineer, Alexander Potter, New York, an unusual method of specifying and paying for some 50,000 cu.yd. of concrete placed in various works constructed during the years 1930-32. The communities included in the Joint Meeting are the townships of Hillside, Irvington, Maplewood, Millburn and Union, the town of West Orange, the village of South Orange, the borough of Roselle Park and the cities of Summit, East Orange and Newark, all in Essex and Union counties. The concrete work was contracted on the basis of a bonus for excess strength and compensation for extra precautions in winter concreting. The procedures followed and the results obtained are summarized in the following article. —EDITOR.

THE CONTRACTS for the Joint Meeting system of trunk sewers and sewage-treatment plant involved the use of concrete which had to be placed under difficult conditions, involving work in deep trenches and quicksand; the lining of tunnels in earth and rock; placing concrete in difficult formwork for special sewer transitions; crossings of main-line railroads; river crossings and sewer junctions, and numerous other special structures. In addition, a considerable portion of the concrete had to be poured during winter.

The works were all to be used to convey sewage to the outfall waters, both as conduits and as structures in which certain treatment processes were to be performed. Because of this use, the hazards involved in interruptions of service due to structural failure, excessive cost of duplication and repairs, structural strength, imperviousness and a minimum possibility of disintegration from exposure to sewage and sewer gases were all essential qualities in the concrete to be produced. In sewage works, failure more often results through disintegration due to lack of density than from structural insufficiency. Particularly in northern climates, where wetting, drying, freezing and thawing are always encountered, density is one of the most important factors in concrete.

Strength classification and bonus clause

In preparing the specifications for the first of the several contracts, which was let in November, 1930, the old method of specifying concrete by volume, without a strict specification on water content, was not adopted; the theory was that this method did not result in a uniform concrete, nor insure the engineer either high or uniform strengths.

Since a considerable portion of the work contemplated was likely to be performed during winter months, special attention was also given the matter of the strength-temperature relation. From tests performed by the University of Illinois, it has been established that concrete allowed to harden at a temperature near freezing for 28 days, will have a strength of only 60 per cent of that shown by concrete cured in a temperature of 70 deg. F. This fact also suggested the desirability of so specifying the concrete as to obtain a strength not below a certain minimum, rather than to specify a constant mix, subject to varying external conditions affecting strength and quality.

It was therefore decided to specify the various classes of concrete by means of a strength classification. Though a mix was suggested in the specifications for the several classes, the proportions of sand, stone and cement to be used were optional to a great extent with the contractor. It was recognized, however, that strength alone should not govern the proportioning of concrete, for it is generally known that frequently where strength requirements have been met, especially where certain cements of high early strengths are used, concrete deficient in durability may be obtained. To obtain a durable and close-texture concrete, therefore, additional controls were specified, such as the water-cement ratio for respective 28-day strengths, characteristics of the cement to be used, and slump limits for the different types of concrete.

Thus bid prices were received on concrete on the basis of the various strengths classified.

In addition to the base-strength classification, a clause providing for a bonus system of payment for such concrete, wherein the strength exceeded the base strength specified, was introduced into the specifications.

It was intended by this means, not only to provide an equitable arrangement whereby contractors were compensated for value which they delivered

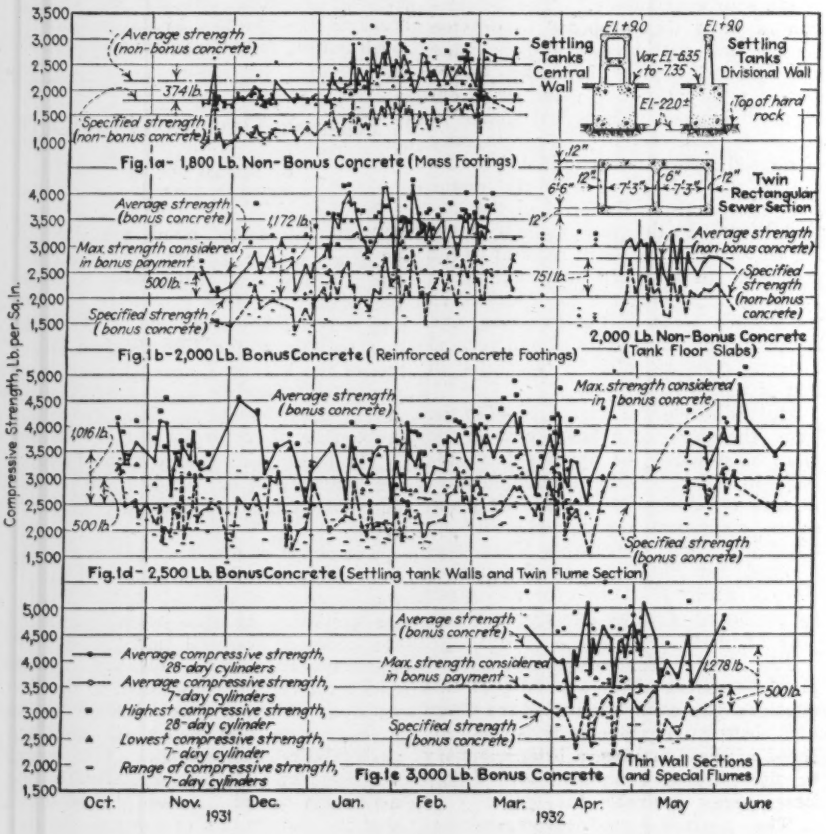


Fig. 1—Graphs showing increased concrete strengths that are obtained by paying bonus for extra strength on five sewage-works contracts.

beyond that contracted for (that is, concrete quality beyond that covered by the bid price), and so provide the necessary impetus which would automatically result in obtaining the proper workmanship necessary for good concrete, but also to compensate for the extra cement and other materials as well as labor required to obtain the minimum strength specified under adverse external conditions.

Extra compressive strength thus obtained through the inducement provided by the bonus payments would have additional value in several other respects in addition to merely providing more compressive strength. For example, researches of the Portland Cement Association and others have definitely indicated that concrete of higher compressive strength is also more watertight, and that the very desirable qualities of strength, watertightness and durability go hand in hand with a low mixing-water content. Thus, in hydraulic structures of the type included in the contracts, while the structural designs for them were based upon the base, or minimum strength specified for the various classes, additional watertightness and durability resulting from increased strength were made possible in an economic manner through the bonus payments provided.

The clause covering the bonus payments for concrete in the specifications was as follows:

> The contractor will be compensated for obtaining strengths in excess of those specified for all concrete under Items ———, on the basis of a maximum payment for a 500 lb. excess.
>
> The compensation per cubic yard for each hundred pound unit compressive strength obtained in excess of the strength specified shall be 25c. between April 15 and Oct. 15 inclusive, and shall be 50c. between Oct. 16 and April 14 inclusive. The latter payment is made higher to provide compensation for the additional precautions required for winter concrete.

Bonus considered in bids

It will thus be seen that the payment of a bonus above the price bid for the base strengths, where the actual strength exceeded the specified minimum, was not intended to represent a gratuitous payment to the contractor, but was a means of inducing and paying for value received.

As will be observed by reference to the divisions of Fig. 1, contractors, in shooting for the maximum bonus payment, constantly exceeded the specified strength, not only by the 500 lb., payment for which was allowed under the bonus terms, but in general by an additional 800 lb. over and above the maximum strength considered in the bonus payment, for which no additional compensation was allowed.

Shortly after the first contract was let for the trunk sewer construction in 1930, and contractors had had an opportunity to observe how the system of bonus payments for concrete functioned, it was found that in subsequent contracts in which the bonus clause was included, well-informed contractors modified their bids to the extent of lowering their unit prices on concrete items by an amount equivalent to the bonus on excess strengths which they predicted they might earn. The bonus thus made available afforded a method for the most efficient and reputable contractors to cut their bids, knowing that they would be reimbursed, particularly in the winter time, for the necessary precautions and extra materials and labor.

On such contracts it was soon found that all contractors and their forces, out of necessity, became imbued with a "quality concrete" conscience, and the making of good concrete, with all the care that that implies, was the order of the day. It is natural enough that this should be so, for, due to the keen competition always present in bidding work of this kind and the lowering of the base prices bid for concrete in anticipation of an earned bonus, the failure to earn this bonus would mean a substantial reduction in anticipated profits on the contract.

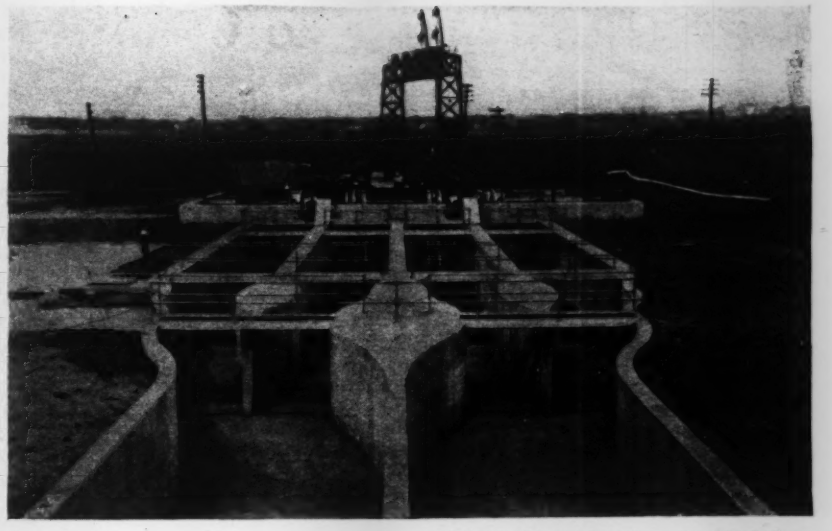


Fig. 2—Treatment plant in Elizabeth, N. J., showing grit chambers and transitional flumes at downstream end. Screen house substructure in rear. Screw conveyor and other equipment installed.

Bonus vs. non-bonus concrete

On contract D, Fig. 1, involving the main construction contract for the sewage-treatment plant, approximately 27,500 cu.yd. of concrete was poured. Of this quantity, about 14,000 cu.yd., or 50 per cent of the total, was non-bonus concrete. The reason for this is that after the contract was let, foundation conditions, as disclosed by actual excavation, were found to be quite different from those indicated by information previously obtained from borings. The disclosed conditions of the foundation material necessitated a radical change in the design of the foundations of the settling-tank walls. Inasmuch as this revision necessitated much more concrete than the quantity upon which bids were received (the bid quantities being classified as bonus concrete), and also because all of this additional quantity was to be placed as mass concrete, it was agreed to fix a unit price for all concrete for the new foundation work, without bonus payment.

This situation presents an opportunity to compare strengths of concrete obtained by bonus and non-bonus methods of payment on the same job. Reference to Fig. 1a indicates that the arithmetical average of the 28-day compressive strengths of standard 6x12-in. cylinders of the non-bonus concrete was only 374 lb. in excess of the specified strength for the 1,800-lb. classification, while reference to Figs. 1b, 1d and 1e indicates that the arithmetical average compressive strengths of the bonus concrete were 1,172 lb., 1,016 lb. and 1,278 lb. respectively, in excess of the specified strengths, the bonus payment in each case being limited to a maximum of 500 lb. excess strength.

In comparing these results, consideration should be given to the fact that the same degree of inspection was given to both the bonus and non-bonus concrete, as the work on both classes was carried on simultaneously under the same supervision and under the same contract.

Concrete control

During the progress of the work, over 4,600 cylinders were taken for testing purposes on the four contracts referred to. In only one case on the trunk sewer contracts and one case on the treatment plant did concrete fail to come up to specified strength as determined both from cylinder tests and check cores removed from the questionable sections. Sections represented by these tests were promptly removed and replaced with concrete of the required strength and quality.

Six standard cylinders were taken of

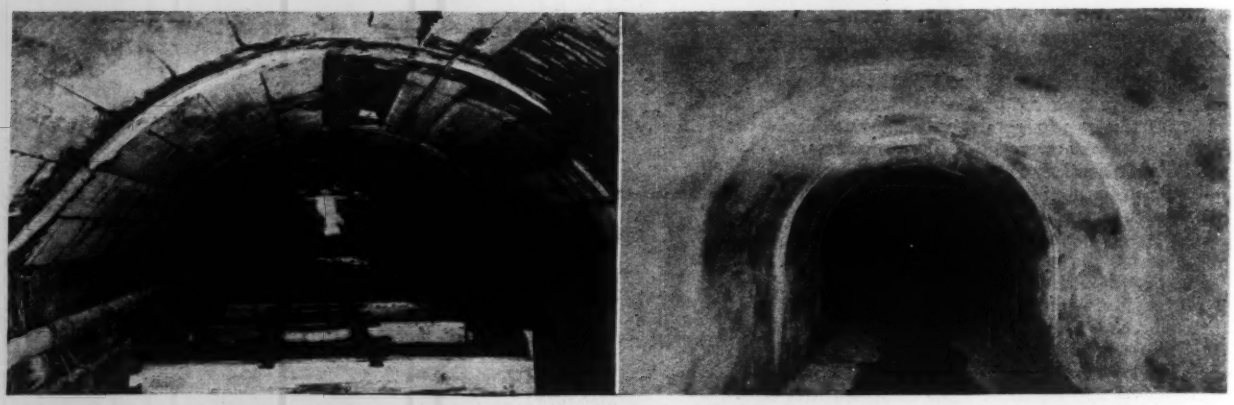


Fig. 3—Trunk sewer tunnel ready for invert. Tracks in position for pouring concrete (at left). Finished concrete sewer in tunnel (right).

each day's run of each class of concrete, two of these being broken at 7 days and the remaining four at 28 days. A complete record of all pours was kept, showing actual location, class, quantity poured, conditions under which pour was made, weights of all materials, slump tests and cylinder numbers. Cylinders were cured one day under job conditions and then removed to the laboratory for testing. In computing amounts of bonus earned on a given pour, the average strength determined from the 28-day cylinders taken from that particular pour was used, thus resulting in a bonus over the entire job as based on a weighted average strength.

Bonus economics

The table is presented to show the additional cost of bonus payments on the basis of cost per 100 lb. excess strength per cubic yard of concrete, as it actually worked out in each of the several major contracts in which this method of payment was specified. In addition, data are presented showing unit base prices bid for the various strength classifications.

Considering similar types of work in which concrete was placed, it will be observed that the average cost paid out as a bonus in terms of cost per "100 lb. excess strength per cubic yard," considering the various contracts as a whole, amounted to $0.164 (max. $0.193, and min. $0.133), while the average differential base price bid per 100 lb. strength per cubic yard on similar types of concrete work was $0.385 (max. $0.625 and min. $0.20). In other words, it might be stated that the payment of a bonus thus resulted in an actual saving. Of course, consideration should be given to the difference in formwork required for the various classes of concrete, thus resulting in a higher differential price when considering bid prices. However, in the above comparison, similar types of concrete work, requiring in general similar formwork, were considered in obtaining the average costs.

While it is brought out above that the payment of a bonus resulted in a saving, it is to be noted that at the same time it unquestionably resulted in fair compensation to the contractor, for he was under no obligation to supply excess strength to any degree other than that which he could provide at a reasonable profit to himself under the provisions of the bonus-payment clause.

Thus the question of what differential price should be allowed for concrete to be placed in similar types of construction, but of different strength classifications, will, in cases where base-strength prices and bonus payments prevail, seek its own level, which in the case at hand has worked out to be about one-half of the differential price obtained when left open to bidding.

The actual amount of the unit bonus allowed in the specifications was not arrived at arbitrarily but was based upon a study of the extra materials and care required to produce the necessary strengths under the conditions existing. For example, a study was made of the low mean temperatures that were likely to occur in the area of the work. From results of experimental studies carried out by the University of Illinois and published by the Portland Cement Association, the per cent of normal strength that would be available at the various temperatures predicted was then obtained. This, of course, was made on the assumption that no external heat during curing would be provided. Proceeding in this manner, therefore, it was

BONUS PAYMENTS AND BID PRICES IN TERMS OF STRENGTH-BONUS UNITS

		Strength Data					Cost Data					
Date of Bid and Contract	Place Used	Specified Strength (28-Day) Lb. Per Sq.In.	Actual Strength Obtained (28-Day) Lb. Per Sq.In.	No. of (28-Day) Cyls. Tested	Excess Strength Over Specified Strength Lb. Per Sq.In.	Excess Strength Over Maximum Allowed in Bonus Payment Lb. Per Sq.In.	Unit Price Bid at Base Strength	Differential Bid Price	Differential Bid Price Per Cu. Yd. Per 100 Lb. Differential Strength	Total Bonus Paid	Total of Bonus Concrete Cu.Yd.	Actual Bonus Paid Per Cu. Yd. Per 100 Lb. Excess Strength Obtained
July 16, 1931 Contract "D" Disposal Plant	Transitions, Venturi Meters, Thin Walls	3,000	4,278	189	1,278	778	$12.00	.....	.....	$1,911	1,178	$0.127
	Tank Walls	2,500	4,023	447	1,523	1,025	11.00	$1.00	0.200	11,988	5,653	0.141
	Reinforced Footings	2,000	3,172	261	1,172	672	10.00	1.00	0.200	5,993	2,815	0.181
	Mass Footings	1,800	(Non-Bonus Concrete)				8.50	1.50	0.700*	(Non-Bonus Concrete)		
								Averages	0.200			0.150
Feb. 5, 1931 Contract "C" Trunk Sewer	Transitions and Junctions	3,000	4,276	185	1,276	676	16.00	.....	.....	1,810	792	0.178
	Manholes, etc.	2,000	2,887	31	887	287	12.00	4.00	0.400	249	153	0.183
	Cradles, Sills, etc.	1,800	(Non-Bonus Concrete)				11.00	1.00	0.500	(Non-Bonus Concrete)		
								Averages	0.450			0.181
Oct. 23, 1930 Contract "B" Trunk Sewer	Venturi Meters	3,000	4,834	15	1,834	1,234	20.00	.....	.....	225	75	0.163
	Tunnel Lining	2,000	3,628	251	1,628	1,028	17.36	2.64	0.264	10,461	6,319	0.102
	Cradles, Sidewalks, etc.	1,800	(Non-Bonus Concrete)				8.65	8.71	4.305*	(Non-Bonus Concrete)		
								Averages	0.264			0.133
Oct. 23, 1930 Contract "A" Trunk Sewer	Flumes at Curves, Highway Crossings, etc.	3,000	3,965	32	965	365	25.00	.....	.....	181	99	0.190
	Twin Flume	2,000	3,074	379	1,074	474	17.50	7.50	0.750	6,931	3,427	0.195
	Cradles, Sills, etc	1,800	(Non-Bonus Concrete)				16.50	1.00	0.50	(Non-Bonus Concrete)		
								Averages	0.625			0.193
							Averages All Contracts—		0.385			0.164

*Values not considered in average, because of type of special work in which this concrete was used.
NOTE: Maximum strength considered in bonus payment was 500 lb. per sq.in. on contract D and 600 lb. per sq.in. on contracts C, B and A.

possible to arrive at the design strengths required throughout the year to result in normal strength when corrected for low-curing temperatures. The cost of providing the higher design strengths and/or other means, as heat and labor, of obtaining normal or specified strengths, was then computed and thus determined the amount of the unit bonus. As pointed out before, however, it is really immaterial whether or not the amount thus determined is absolutely correct, for if it is over or under the estimate, it is balanced by the unit prices obtained through competitive bidding on the base-strength concrete. That is, if more is allowed than is really required, contractors bidding the work in competitive bidding, at least, will reduce the base price accordingly.

While it is difficult to express the science of the bonus method of specifying and paying for certain types of concrete work by means of mathematical formulas or curves, the practical value of so doing, however, has been amply illustrated by the results obtained on the work mentioned. Growing confidence among engineers that concrete designed for a certain strength, together with a means of insuring fair compensation, thereby eliminating the uncertainty of the human element in producing concrete, and incidentally giving efficient and reputable contractors the edge in bidding, should tend to decrease the gap between ultimate strength and working stress used in designs, with obvious advantages in economy.

On the trunk sewer construction, contracts A, B and C were held by the D. & M. Contracting Co., Maplewood, N. J.; Northern States Contracting Co., St. Paul, Minn.; and Thomas Burke and Co., Philadelphia, Pa., respectively. Contract D for the treatment plant was held by the Northern States Contracting Co., St. Paul, Minn. Arthur T. Armstrong was resident engineer on the trunk sewer work, with George W. Hackett, resident engineer on the treatment plant. Elson T. Killam was engineer of designs on the four contracts. The three last-named men were from the office of Alexander Potter, chief engineer of the project.

Soil-Erosion Control by Terraces

Engineering research on experimental farms has determined the influence of terrace slope, spacing and length upon the waste of soil and water

By C. E. Ramser
Senior Drainage Engineer, U. S. Dept. of Agriculture, Guthrie, Okla.

FOUR YEARS of large-scale research to determine methods of combatting farm erosion have succeeded in bringing out a number of definite facts on the efficiency of the terrace method. It has been established that the tremendous soil losses now suffered by many regions can be greatly reduced, and that at the same time a large proportion of rainfall now lost to the land can be saved. As the work so far done extends over a large range of soil and climate, the conclusions are believed to be generally valid. Further work is under way.

The objects of the investigation are to determine the fall, vertical spacing and length of terrace; to determine the effectiveness of terraces in preventing erosion and conserving moisture; to develop the most economical methods of constructing and maintaining terraces; to determine the best available machinery for building terraces; to study the operation of various types of farm machinery over terraced land; and to improve the design and reduce the cost of various types of check and soil-saving dams to control erosion in road ditches, gullies and at the ends of terraces.

Results of tests

At some of the soil-erosion stations sufficient information has been obtained to show the effectiveness and value of terraces in reducing soil losses. On the Red Plains station, near Guthrie, Okla., 43.9 tons of soil per acre were lost during 1931 from an unterraced area, as compared with 1.25 tons per acre from a level terraced area, both areas being planted to cowpeas and having somewhat similar cover crops. That terraces are effective in controlling erosion on the experimental farm at Hays, Kan., is evidenced by the fact that in a 2½-in. rainfall terraced land with a slope of 8 per cent, planted to kaffir, lost less than 2 tons of soil per acre, while unterraced land of 5 per cent slope lost 14 tons, or more than seven times as much.

At Bethany, Mo., land planted to corn lost 2.64 tons of soil per acre from a level terraced area, as compared with 104 tons per acre from an unterraced check plot, during a twelve-month period. At Pullman, Wash., where moisture conservation is also a problem, 75 per cent of the rainfall and more than 7 tons of soil per acre were lost from an unterraced field in winter wheat, as compared with 2½ to 10 per cent of the rainfall and 0.02 to 0.09 tons of soil per acre lost from a terraced field, January to March, 1932.

At Guthrie, on terraced areas otherwise comparable, soil and water losses from cultivated land severely eroded prior to terrace construction were twice as great as from land recently broken out. The cost of building terraces on the badly eroded and gullied land was more than six times as great as that of building terraces on the newly broken land where no gullies existed. The economy of terracing farm lands immediately after they are first broken rather than waiting until gullying starts, is further emphasized by the fact that the yield of lint cotton on the new land was 34 per cent greater than on the eroded area.

The comparative effect of various crops in reducing erosion and runoff losses during a rain of 2.42 in. is shown in results obtained from an experiment on the farm at Temple, Tex. The percentage of rainfall that ran off from terraces planted to oats was 6, to cotton 16 and to corn 40, and the respective soil losses from the three terraces were 48, 138 and 1,325 lb. per acre.

Effect of grades

Outstanding among the results obtained on the design of terraces is the information collected on the farm at Tyler, Tex., which supports the recommendations made by the bureau in 1916 that a terrace with a variable grade is

Broad-base ridge terraces, showing cross-section and rows parallel to terrace.

Harrowing over a terrace on ground that slopes 40 per cent presents no difficulty, as shown by operations in the Palouse region near Pullman, Wash.

more effective in controlling erosion than a terrace with uniform grade. Measurements of the discharge from two terraces 700 ft. long, one with a uniform fall of 6 in. per 100 ft. and the other with grade varying from 0 to 6 in. per 100 ft., showed that two-thirds more water and one-third more soil were removed from the former during the year 1931. At Bethany, Mo., the relative efficiency of variable and uniform grades was indicated by an experiment consisting of two terraces about 1,200 ft. long, one with a uniform fall of 4 in. per 100 ft. and the other with a fall varying from 0 to 4 in. per 100 ft. Nearly twice as much soil was lost from the uniform graded as from the variable graded terrace.

At Guthrie level terraces permitted a loss of only 1.25 tons per acre, the loss with terraces having 6 in. fall per 100 ft. was 5.46 tons per acre, or more than four times as much. Similarly, at Tyler, Tex., the soil loss from a terrace 700 ft. long with 6-in. grade was one-third greater than the soil loss from a terrace of the same length with only 3-in. grade. At Bethany, Mo., the terrace most efficient in conserving soil was level, 1,200 ft. long with 5-ft. vertical spacing, located on a 12 per cent land slope. The soil loss from this terrace was but 28 per cent of that which occurred with a similar terrace having a fall of 6 in. per 100 ft. However, there was considerable damage to crops, due to water standing in the terrace channel, which suggests that the use of level terraces in this region may be limited.

Spacing and length

Results of an experiment at Guthrie show that soil losses are greater for the wider vertical spacings between terraces. With terraces 700 ft. long, having a uniform grade of 4 in. per 100 ft., the average soil loss was 2.74 tons per acre with 2-ft. spacing, 3.96 tons per acre with 3½-ft. spacing, and 4.98 tons per acre with 5-ft. vertical spacing between terraces.

Short terraces are somewhat more effective than long terraces in controlling soil erosion. At Tyler, Tex., about 20 per cent more soil was lost from two terraces 1,700 ft. long with spacings of 4 and 5 ft. than from two terraces 700 ft. long with the same spacings.

The construction of terraces with closed ends (designed to prevent all surface runoff) was found to be impractical at the Guthrie station because of the necessary height of terrace or small vertical spacing, the hindrance to farm operations by wet channels and the reduction in crop yields due to drowning of the crop in the terrace channel. Similar results were obtained at Temple. The slow percolation of the water into the soil is responsible for the impracticability of such terraces. On the contrary, in western Oklahoma and southwestern Texas, where the rainfall is light and the soil is of open texture, increases in wheat yields of 25 to 40 per cent have been recorded on land where all the rainfall is retained by terracing.

Crop rows may be run parallel to terrace or as shown here across the terrace. The crop is soybeans.

Gibraltar Tunnel Surveys

Commenting on the results so far obtained in the surveys now in progress at the Strait of Gibraltar, *The Engineer*, London, in its issue of Sept. 15, 1933, states the following concerning the tunnel proposed for that site:

"Preliminary surveys for the proposed tunnel under the Strait of Gibraltar show that the geological conditions are favorable to the successful carrying out of the scheme. When the surveys are completed, toward the end of next year, it is hoped to constitute an international company with British, French and Spanish capital, but the work of constructing the tunnel will not be started until there is some assurance that the African railway projects will be put in hand at the same time. One of these is a railway along the west coast through French Morocco and the Rio del Oro to Dakar for the traffic with South America; another is the Trans-african Railway across the Sahara Desert, which will be connected with the Belgian Congo railway system, and eventually with the railway to the Cape; and, finally, there is a scheme for extending the railways across North Africa to Egypt. The lesson of the tunnel through the eastern Pyrenees, which has failed to fulfil the promise of promoting commercial activity made at its inauguration some years ago, is not lost upon the promoters of the Gibraltar tunnel, who intend to make sure that railway enterprise in Africa will justify its construction. The Spanish decree of December, 1931, which modified the character of the commission of inquiry formed in 1928, declared that the object of the tunnel was to make the Spanish railway system a link in a chain of communications with Europe, Africa and America. It is proposed to construct the tunnel from a point 5 miles west of Tarifa in Spain to Cale Hermosa in Spanish Morocco, a distance of about 20 miles. There will be two tunnels, with lateral tunnels every 200 m., and the maximum depth below water level will be 370 m. The maximum gradients will be 3.6 per cent. The strategical value of the tunnel will raise political problems which will have to be settled before the undertaking can be put in hand."

Seattle Remodels Its University Bridge

Wider permanent approaches replace timber trestles—Bascule widened by cantilever roadway and equipped with unique open-mesh steel deck

By J. A. Dunford
City Engineer's Office, Seattle, Wash.

A TRAFFIC-RELIEF improvement of major importance was completed in Seattle, Wash., with the opening early this summer of the remodeled University Bridge, which connects the main business district with the section surrounding the University of Washington. Unusual interest also attaches to the structure because of the use of an open-mesh steel deck on the bascule span. The design of this deck was fully covered in an article in *Engineering News-Record*, Nov. 24, 1932, p. 624, so that the present account is in the nature of a résumé of the whole job, after its completion.

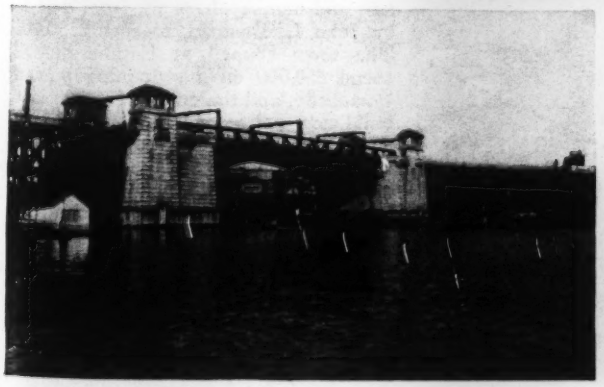
The University Bridge is one of three built across the Lake Washington Ship Canal by the city in 1916-1919. The original cost of the structure was $830,000, which included a bascule span of permanent construction and temporary untreated timber trestle approaches. The overall length was 1,468 ft. and a roadway width of 40 ft. was provided. From the time the bridge was opened in 1919 until 1931 when it was closed for reconstruction vehicular traffic increased from 8,000 vehicles daily to 38,000. In the new approaches the steel trusses, resting on concrete piers, have a roadway width of 58 ft. between curbs. Remodeling of the bascule consisted in providing two extra traffic lanes outside the old bascule trusses, utilizing shop-welded cantilever girders for supports. Steel-mesh flooring was installed as a new deck between the bascule trusses and also on the lanes outside of the trusses. The contract also provided for a temporary detour structure with a single leaf bascule draw to accommodate street cars and a limited vehicle traffic during the time the permanent bridge was out of service. The total cost of the remodeling was $612,196, of which nearly $500,000 went into the approaches. The bascule widening was done for $73,088.

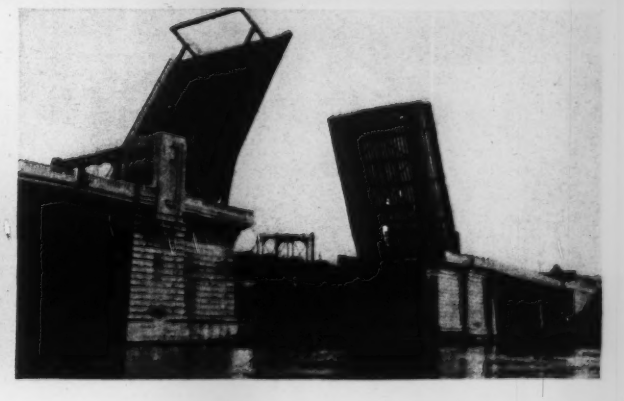
A total of 1,700 tons of steel was used in the approaches. The deck trusses were shop-fabricated in 40-ton sections, shipped to the site on scows and lifted into place by a floating derrick. Principal interest, however, centers in the bascule reconstruction where the problem was to add a 9-ft. roadway and a 4-ft. sidewalk outside of each truss, without seriously overloading the span or greatly increasing the counterweight space. The necessary solution was an unusually light floor not only for the new roadways but to replace the existing wood block floor; also the use wherever possible of arc-welded construction.

The outer roadways, as built, are supported on steel brackets, tied to the floor beams through slots cut in the vertical members of the bascule trusses. As shown in Fig. 3, the brackets were designed with tapered bottom flanges of

Fig. 2—Reconstructed University Bridge, Seattle, showing the new approaches and the widened bascule which is equipped with an open-steel mesh deck. A roadway width of 58 ft. is provided. On the bascule this is obtained by new cantilever roadways outside the trusses. Buildings of the University of Washington are shown in the right background.

Fig. 1—The University Bridge in Seattle before and after remodeling. The old timber trestle approaches were replaced by modern concrete-and-steel deck spans and the bascule was widened by cantilever roadways outside the trusses, equipped with open-steel mesh decks as shown at the right. The temporary bridge used during the reconstruction may be seen through the opened bascule.





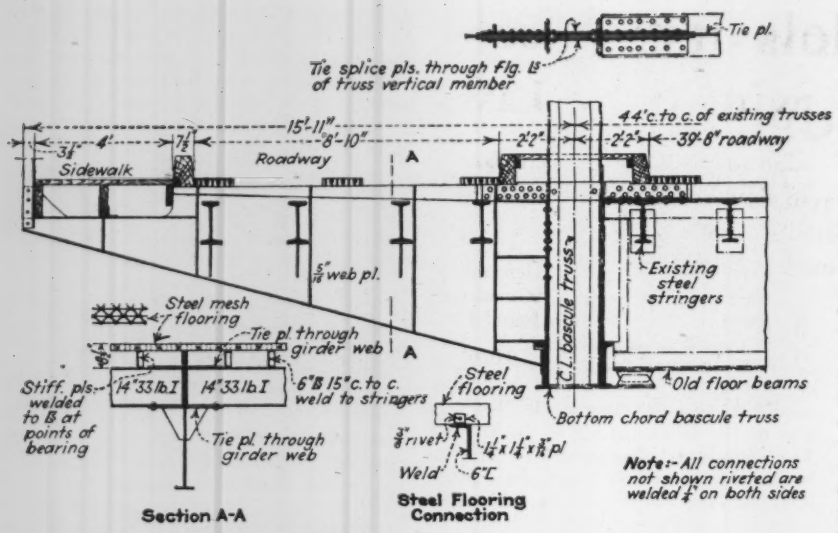


Fig. 3—Details of roadway added outside of bascule trusses. Welded construction is a feature of the 16-ft. cantilever brackets and of the stringer connection. The steel mesh flooring is welded to transverse 6-in. channels, in turn welded to the stringers.

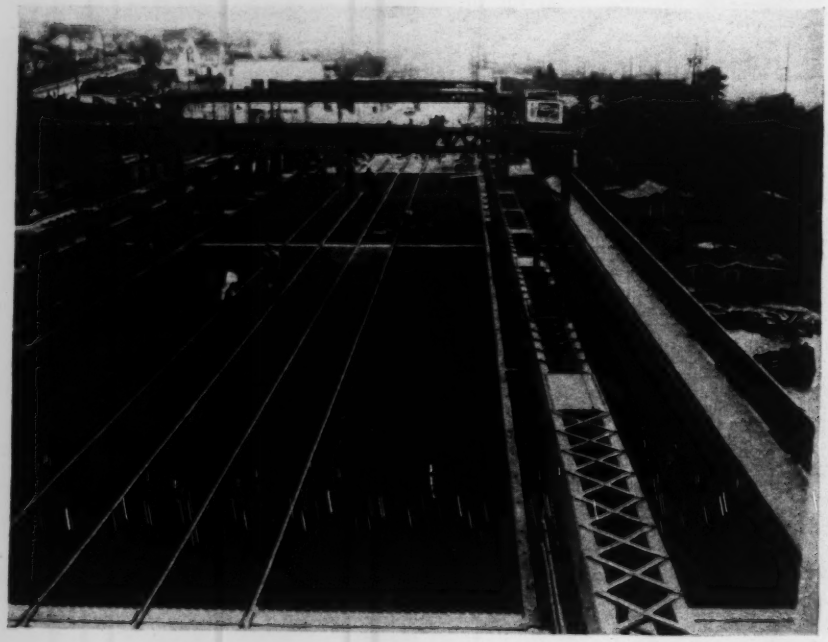
steel plates and with stiffeners also of the single-plate type, welded to the web. The top edges of the brackets are without flanges and are brought to a level with the 6-in. transverse channels that rest on the stringers and act as supports for the 15-lb. per sq.ft. steel-mesh flooring. The outer-roadway stringers are tied through slots in the bracket webs with plates welded to the upper and lower flanges of the stringers, giving these members added stiffness. To facilitate erection, enough rivets were used in the stringer connections to make a safe assembly, and all tension connections for the brackets were made with rivets. At points on the span where the brackets could not be connected to floor beams, 6x1-in. bars were passed across the floor system, tying the brackets together and also acting as a support for the steel flooring.

By the use of this type of design 113 tons of weight was added to each bascule leaf, and 85 tons was removed, a net increase of 28 tons, as shown by the following figures:

Materials Added to Each Bascule Leaf	Tons
Structural-steel supports and hand-rail	55
Steel floor materials	44
Lumber in curbs and sidewalks	14
Total	113

Materials Removed from Each Bascule Leaf	Tons
Steel sidewalk brackets and handrail	9
Lumber including paving blocks	76
Total	85

Fig. 4—Lightweight open-mesh steel deck on bascule leafs of University Bridge, Seattle, showing new roadways outside of trusses.



To balance the additional weight of 28 tons per leaf, the counterweights were increased 56 tons by adding a mixture of steel punchings and cement mortar weighing 6,327 lb. per cu.yd., of which the punchings accounted for 4,300 lb.

The open-mesh floor has attracted the attention of engineers and others interested in highways, and many inquiries have come to the city engineer's office. Regarding the attitude of the traveling public, the open floor has been well accepted. Strangers cross the span apparently unaware of the open spaces which, in fact, are usually not noticed because of the angle at which the roadway is viewed from a moving car. The open mesh has not proved to be slippery when wet. Tests made with a special recorder showed the steel paving to be equal to new concrete in its ability to stop a car, and under frost and oil conditions it was found to be superior, since oil and frost quickly disappear from the steel under a small amount of traffic. The roadway itself is not ideal for horse-drawn vehicles, but it is thought that the few draft and saddle horses still on the streets can very well detour to some of the other canal bridges.

The bridge was built under the direction of M. O. Sylliaasen, city engineer of Seattle. O. A. Piper is principal assistant city engineer. The writer was in charge of the bascule improvements, and C. H. Eldridge, bridge engineer, was in charge of the permanent approaches.

Many Municipal Projects Announced in Great Britain

The general activity in municipal construction throughout Great Britain and the excellent financial status of its towns and cities are well illustrated by the size and number of important new projects recently announced. The Manchester Corporation is to extend its town hall, at a cost of £1,000,000, and the town council at Cambridge, the university seat, is to erect a new guildhall and municipal offices, the designs for which are to be prepared by C. Cowles-Voysey. Brighton Corporation is to erect a town hall and municipal offices, from designs by John L. Denman, to cost £250,000. The town council at Edinburgh will spend £50,000 on a swimming pool at Portobello, and the city of Carlisle is to build new police and fire stations at a cost of £45,000. Liverpool is to rebuild its Philharmonic Hall, recently destroyed by fire, on which £100,000 will be spent. Plans are complete for a new sewerage and drainage works at Glasgow, involving an expenditure of £3,000,000, and the towns of Barnet and Aldenham will expend £100,000 for a similar purpose. The Corporation of Boston is inviting tenders for sewerage work to cost £115,000.

Resistance to Flow of Molasses Found to Agree with Basic Laws

Tests show that loss of head through long pipe is in accordance with laws governing resistance to flow of other viscous fluids

By Glen N. Cox

Associate Professor of Mechanics and Hydraulics, Louisiana State University, Baton Rouge, La.

EXPERIMENTS on the flow of molasses through pipe, conducted at the Louisiana State University sugar house, demonstrate that the fundamental laws of hydrodynamics apply to this material just as accurately as they do to oil and other viscous fluids. It has heretofore been assumed that this was the case, because of the lack of experimental data, in problems involving the pressures needed for pumping molasses, but the investigation was carried out to see if the assumption was valid.

Experimental layout

The existing piping in the Louisiana State University sugar house was used. This is a four-story building with the pumps on the first floor, weighing tanks on the second and the bulk of the sugar-making apparatus on the third and fourth floors. With this arrangement the molasses was pumped from the first floor to the third floor where the pressure readings were taken. The molasses then passed into the weighing tanks on the second floor, and after being weighed it was pumped to the suction tank on the first floor to be used again. A run of 1½-in. pipe on the third floor was used for the test, with a gage length of 42.16 ft. The actual diameter as given in handbooks for this size of pipe was used in interpreting the experimental data. The pressure drop was read by two Bourdon gages.

The molasses was heated from steam coils in the suction tank, and the temperature was read during each run at the discharge end of the pipe. Care was taken to have only small changes of temperature between runs.

The molasses used was a mixture of beet and sugar-cane molasses, somewhat more fluid than the blackstrap ordinarily encountered. It tested 75 brix at 17.5 deg. C.

A Saybolt Furol viscosimeter was used for determining the viscosity. The absolute viscosity was found by applying the equation $\frac{u}{g} = 0.0204t - \frac{1.6}{t}$ where u = absolute viscosity in poises, g = density or specific gravity, and t = time of efflux in seconds. The viscosity in poises was converted to English units by multiplying by the factor 0.0672.

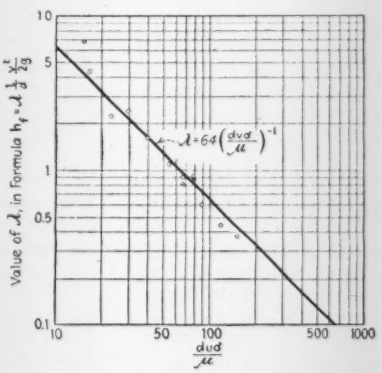


Diagram showing resistance coefficient λ plotted against Reynolds' number.

Experimental results

The d'Arcy formula for the flow of viscous fluids in pipes is

$$h_f = \lambda \frac{l}{d} \frac{v^2}{2g} \text{ and } \lambda = \phi \frac{d v \sigma}{\mu}$$

where h_f = lost head in feet, l = gage length in feet, d = diameter of pipe in feet, v = velocity in the pipe in feet per second, g = acceleration due to gravity, σ = weight of the liquid in lb. per cu.ft., and μ = absolute viscosity in English units.

With any consistent system of units, the term $\frac{dv\sigma}{\mu}$ (Reynolds' number) is an abstract number. Its value may extend from very small values to more than 300,000.

In computing the resistance to flow of a viscous fluid, if the relation between λ and $\frac{dv\sigma}{\mu}$ is known, the value of λ can be determined from the conditions of the problem. The head loss for a given length of pipe can then be computed.

From the observations values of λ and of $\frac{dv\sigma}{\mu}$ were computed for the different runs as shown in the accompanying table, and were plotted on logarithmic paper, as shown in the figure. The line drawn on this graph about which the experimental points are grouped indicates the relation $\lambda = 64\left(\frac{dv\sigma}{\mu}\right)^{-1}$ and is that recommended in the "Handbook of the Petroleum Industry" as applying to the flow of oil.

The conditions of these tests did not approach the critical value of $\frac{dv\sigma}{\mu}$ representing the change from streamline to turbulent flow. This value is in the neighborhood of 2,000, which, with a temperature of 20 deg. C., would require a velocity of 65 ft. per second in the 1½-in. pipe and would involve a pressure drop of 810 lb. per sq.in. in a length of 100 ft. It clearly is impossible to operate a molasses line in the turbulent zone without heating the molasses materially.

SUMMARY OF EXPERIMENTAL DATA

Run No.	Temp. deg. C.	Friction Head, Ft.	Specific Gravity	Absolute Viscosity, English Units	Velocity, Ft. per Sec.	λ	$\frac{dv\sigma}{\mu}$
1	11.6	49.26	1.386	0.924	1.22	6.80	15.3
2	11.3	46.74	1.386	1.036	1.49	4.32	16.7
3	15.0	11.09	1.385	0.630	0.63	5.70	11.6
4	15.0	31.04	1.385	0.630	1.62	2.425	29.8
5	18.0	43.14	1.383	0.458	3.10	0.920	78.5
6	18.6	37.47	1.383	0.434	2.95	0.882	78.8
7	18.5	16.79	1.383	0.438	1.49	1.596	39.5
8	18.5	22.83	1.383	0.438	2.06	1.100	54.6
9	19.1	23.29	1.383	0.422	2.42	0.815	66.5
10	20.8	18.33	1.382	0.354	2.04	0.903	66.9
11	20.7	5.41	1.382	0.357	0.71	2.210	23.1
12	21.3	34.99	1.382	0.338	4.38	0.374	150.3
13	21.3	19.50	1.382	0.338	2.58	0.600	88.5
14	21.7	23.97	1.381	0.326	3.33	0.442	118.3

Free City of Hamburg to Raze Slums

In line with the general policy being followed in various large cities in Europe, the Free City of Hamburg will clear its slums and erect in their place modern five- and six-story houses containing small apartments, according to a report from the consul general at Hamburg.

About 12,000 persons will be affected in the building program, of which 9,000 can be rehoused at once, at rates prevailing in the slum areas at present. They will be placed in buildings, now largely untenanted, erected with public funds under the former government of Hamburg.

A special law will be enacted to counteract speculation in connection with the sites to be cleared, and an average price is to be fixed on the basis of profits anticipated from the new houses.

Dilapidated and neglected buildings not offered for clearance will be ordered vacated. The work of clearing the slums, it is believed, will aid materially in the employment of many people now without jobs.

Friction of Lubricants for Laminated Concrete

Friction tests made on variety of lubricants for use between laminations of the facing for San Gabriel flood-control dams—Preliminary high-pressure friction tests indicate that greater pressure results in lower coefficient

By E. C. Eaton

Chief Engineer, Los Angeles County Flood Control District, Los Angeles, Calif.

LUBRICATION requirements between the laminated reinforced-concrete facing slabs on the two San Gabriel rockfill dams being built by the Los Angeles County Flood Control District resulted in an extended series of tests to determine properties and coefficients of various materials. The facing at the toe of No. 1 dam, a record-breaking structure containing 6,000,000 cu.yd. of rock and rising over 300 ft. above streambed, will consist of laminations of six 6-in. slabs, decreasing to two slabs at the crest. With the individual slabs 30 ft. square, overlapping joints and the pressures resulting from a full reservoir, the question of a lubricant satisfactory for varying temperatures, pressures and weather conditions was particularly important. In addition to physical tests, a series of friction tests was made, and although this study is incomplete, a brief résumé of typical results obtained may be of interest.

From the preliminary studies it was indicated that a comparatively low coefficient of friction was desirable combined with good waterproofing qualities, reasonable elasticity and resistance to weathering. The first tests included a series using low pressures ranging from 1 to 2 lb. per sq.in. Although these tests gave results of reasonable consistency, the heavy pressures to result in actual practice indicated that a further series of high-pressure tests with loads up to 100 lb. per sq.in. was desirable.

Low-pressure tests

For the low-pressure friction tests a level concrete surface was covered with the lubricant to be tested, and on top of this was super-imposed a number of 12x12 in. blocks each 6 in. thick. The necessary load was obtained by adding additional blocks, and the load was dragged across the asphaltic surface by means of a wire attaching a spring scale to the moving head of the testing machine. Different degrees of heat were obtained by making tests during various hours of the day through a wide range of weather conditions. A thermometer in one of the lower blocks provided a measure of the temperature at the joint. The general set-up of this testing arrangement is shown in Fig. 1.

To provide information on the effect of temperature range on the friction properties, the tests were made through a range of about 30 deg., the variation to be encountered during loaded conditions on the facing. The summarized results of these tests are shown in Table I, which indicates the coefficient for the extreme high and low temperatures, eliminating the extensive series between these temperature limits.

In the use of asphaltic material as a lubricant the coefficient of friction cannot be properly determined or evaluated without introducing the temperature and rate-of-movement factors. For example, one of the best asphaltic materials tested showed coefficients of friction ranging from 0.68 at 44 deg. F. to 0.24 at 80 deg. F. for a movement of 0.01 in. per minute. This same sample indicated a coefficient of friction of 0.62 at 56 deg. F. for the same rate of movement, and just before coming to rest it showed a coefficient of 0.30 for the same temperature.

In the dam the 6-in. by 30-ft. facing slabs will be anchored 5 ft. from the top so that the greatest expansion from temperature will be over a length of 25 ft. Using 0.000006 as a coefficient of expansion for concrete over a range of temperature from 50 to 90 deg. F., which is considered excessive, the linear expansion of the slab would be 0.072 in. Using a coefficient of expansion of 0.0004 for asphaltic material over the same range of temperature the linear expansion would be about .5 in. for the lubricating material. Therefore, the major part of the movement between slabs resulting from extreme daily temperature changes would be within the asphaltic material itself during dry seasons when the reservoir will be empty.

It is considered likely that the daily range of internal temperature between slabs would not be more than 20 deg. F. —say from 60 to 80 deg. F. in summer and from 40 to 60 deg. F. in winter. The linear expansion of the asphaltic material for a 20-deg. change in temperature would be about 0.75 in. over a probable period of eight hours, or about 0.0016 in. per minute. With an average temperature of 70 deg., this material would have a coefficient of friction of about 0.4 at a rate of 0.01 in. per minute, but at the much lower rate of movement of 0.0016 in. per minute the average coefficient of friction would probably be 0.25 to 0.30 or less.

The foregoing computation relative to linear movement of the slab and asphaltic filler considers only the factor of expansion and did not include the question of internal friction, hydraulic shear and other characteristics of this movement. An admixture of 25 to 30 per cent of talc or diatomaceous earth was found to be advantageous not only in stabilizing the temperature susceptibility of the asphaltic filler but proved to be an excellent lubricant in itself. Although it would be practically impossible to compute actual movement between the concrete slab, using this admix material and considering internal friction and hydraulic shear, it is stated as an opinion that a $\frac{1}{16}$-in. coating of this admixture material used between rough concrete surfaces would move materially less than the estimated 1.5 in. for a strictly asphaltic lubricant during a 40-deg. temperature range.

Because of the lack of elasticity of this admix when once squeezed out from

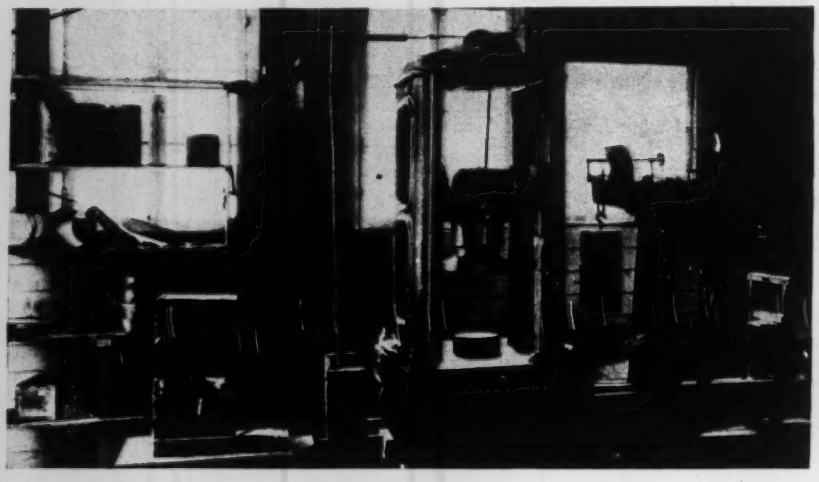


Fig. 1—Arrangement for making low-pressure friction tests, with concrete blocks providing the load (left), and the spring balance (top) measuring the force as the testing-machine head produced the uniform motion.

TABLE I—LOW-PRESSURE TESTS ON COEFFICIENT OF FRICTION

Test No.	Coating Between Concrete Surfaces	Load, Lb. Per Sq. In.	Pull Lb. Per Sq. In	Coef. of Friction	Internal Temperature Deg. F.	Rate of Motion, In. per Min.	Notes
1	⅛-in. { 85% emuls. asphalt, 15% talc	{ 1.4 1.4	1.00 .64	0.72 .46	44 68	0.01 0.01	
2	Building paper coated with paraffin wax	{ 1.9 1.9	1.05 .27	.55 .14	48 70	Broke loose 0.01	{ Concrete surface given asphalt primer coat and, while tacky, sheets of building paper painted with hot paraffin wax applied.
3	Paraffined building paper with talc between	{ .47 1.80	.20 .60	.42 .33	61 72	.016 .016	
4	⅛-in. asphalt	{ 1.9 1.9	1.75 .42	.92 .22	58 84	.01 .01	{ Hot application of air-refined asphalt 180° F.M.P.
5	⅛-in. special lubricant, tar fabric in center	{ 1.8 1.8	.90 .91	.50 .51	45 93	.01 .01	{ Fibrous material dried out and crumbled, fabric did not wrinkle.
7	Steel-floated concrete under varying load	{ .47 2.30	.31 1.68	.66 .73	70 70	.16 .16	
8	Same, powdered talc between	{ .4 2.3 2.3	.25 .90 .69	.62 .39 .30	70 70 70	.16 .16 .16	—After pulling blocks back and forth several times

TABLE II—HIGH-PRESSURE TESTS ON COEFFICIENT OF FRICTION

Test No.	Coating Between Concrete Surfaces	Force and Coefficient Under Varying Pressures: 25 Lb./Sq. In. Force	25 Lb./Sq. In. Coef.	50 Lb./Sq. In. Force	50 Lb./Sq. In. Coef.	75 Lb./Sq. In. Force	75 Lb./Sq. In. Coef.	100 Lb./Sq. In. Force	100 Lb./Sq. In. Coef.
1	None-dry concrete steel-troweled	1,964	1.09	3,424	.95	4,708	.87	5,878	.82
2	Asphalt and admix (190° F.M.P.)	1,104	.61	1,176	.33	1,200	.22	1,144	.16
2A	Same, after standing 1 week under 50-lb. pressure			1,230	.34				
2B	Same, after 4 more days of pressure	1,835	1.02	1,633	.45	1,715	.32	1,440	.20

Temperature = 70°. Rate of Motion = .05 in. per min.

between the slabs into the joints, it would not be pulled back with subsequent contraction. Eventually a state of balance between expansion and friction would be attained with comparatively small loss in this thin layer of asphaltic talc admixture between joints. This admixture remains plastic enough to flow into and heal any small cracks that might develop.

High-pressure tests

To supplement the determination of friction coefficient under test conditions more nearly simulating those in the actual structure, a second series of tests was undertaken, using pressures ranging from 25 to as high as 150 lb. per sq.in. Testing was done by placing a 6x6x4-in. concrete block between two 10x10x4-in. blocks and supporting the group in a steel frame, using a heavy steel spring to equalize pressure. The required pressure was applied by placing this test unit in the compression machine and applying the desired force, after which the frame was fastened with bolts. The force-producing movement was exerted by placing the frame units and springs in the testing machine under the moving head. The force required to produce uniform motion of the center blocks could then be read directly on the beam. This general arrangement is shown in Fig. 2.

As a preliminary test, steel troweled concrete specimens with a dry contact were used. The figures shown in Table II indicate that the coefficient of friction decreased from 1.09 with a pressure of 25 lb. per sq.in. on the blocks to .82 with a pressure of 100 lb. per sq.in. The force necessary to produce motion was not in direct proportion to the pressure.

As the second test, a lubricant consisting of asphalt and an admixture was used between the concrete blocks. The average for five determinations showed that the force necessary to produce motion remained approximately the same at varying pressures. The result was a distinct decrease in the coefficient of sliding friction from .61 at 25-lb. pressure to .16 at 100 lb. As a variation of this test, the blocks were left under a 50-lb. pressure for seven days, and a test was made under 50-lb. pressure, which indicated a coefficient of .34, or practically the same as that obtained before the seven-day period.

After an additional four days, under a constant 50-lb. per sq.in. pressure, a test showed the coefficient to have increased to .45 at 50 lb., but a subsequent high-pressure test at 150 lb. showed a coefficient as low as .12. The first run of this series showed a substantial decrease in the amount of force required as the pressure on the blocks was increased, but the third run of the series resulted in no increase in force required to produce motion even when the pressure was increased to 150 lb.

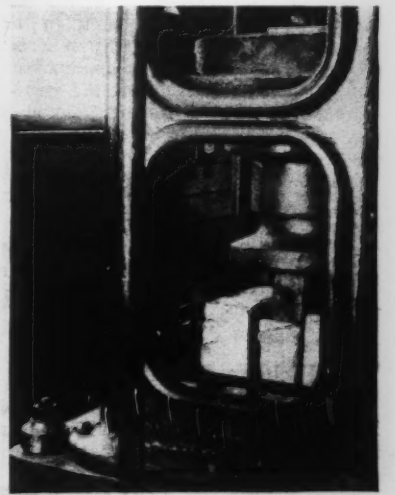


Fig. 2—Set-up for the high-pressure testing with three blocks and two friction surfaces held under measured pressure in a spring frame. The moving head of the testing machine was used to determine the force and the rate of motion.

These preliminary tests produced the rather strange result of indicating that the greater the pressure the less the coefficient of friction, which is indicated both by the figures in Table II and by plotting the results on logarithmic paper resulting in a straight line through all points. A probable cause may be attributed to the fact that the resistance of motion by friction is made up of two parts: (1) shear, which is constant, or practically so; and (2) ordinary friction resistance, or the total force required to move a block across another block as equal to the force required to overcome the shear plus the force required to decrease the friction. While the first is probably more or less constant, the second is a product of the coefficient of friction times the compressive force. From the tests made thus far it would seem that with the lubricant the force causing motion of the slab is more or less independent of the pressure. Slabs without lubricants only approximate this condition.

These general results and conclusions are at variance with the accepted action of friction, which is usually considered to be directly proportioned to the pressure between two bodies. More work will be necessary to extend this study. Further tests are now being carried on, and, in addition, the effect of temperature on asphalt is being investigated as a factor that affects the friction.

The results of tests on dry steel-troweled concrete surfaces varied to such an extent that a further series was undertaken to determine what factors, other than varying load, affected the coefficients. It was found that the movement of the blocks produced a fine dust or dry lubricant that accumulated as the blocks moved, with a resulting polishing action on the surfaces. Both the dust and the polishing action tended to reduce the friction factor, as shown in previous tests. Further, the friction factor was more affected by changing

the orientation of the blocks upon each other.

Conclusions—The tests of the friction coefficients between concrete and concrete were made primarily to check the unusual observations, which indicated that increase in vertical load caused the decrease in the friction coefficient. All tests apparently showed this conclusively, although the friction factor varied more or less between runs, probably due to the variation in surface. The tests made with the asphalt lubricants can now be made with confidence in the general slope of the friction gradient. As stated, the results are preliminary, and an extensive series of additional tests is under way.

The information so far obtained, relative to the actual performance of the various types of materials tested, have indicated a wide variation in behavior of the different classes of lubricants, as well as the importance of careful analysis to arrive at the desired results of flexibility over a wide range of temperatures and pressures.

These studies have been made at the district laboratory under the immediate supervision of S. R. Mitchell, chief testing engineer, and under the general direction of the author.

Recent Welding Studies Reported in Chicago

Papers given at the convention of the American Welding Society furnish data on structural steel, galvanized steel, cast steel and welding under water

AT THE fall meeing of the American Welding Society, held in Chicago Oct. 2-6, a number of papers bearing on some of the problems of structural welding were presented. These are briefly abstracted below.

Welding nickel steel

Experiments and some production welding of structural nickel steel at the Watertown Arsenal were described by W. L. Warner. The material used, mostly plate ¼ in. thick or less, contained: nickel, 3¼ to 3¾ per cent; carbon, 0.30 to 0.40 per cent; manganese, 0.50 to 0.70 per cent; phosphorus and sulphur, maximum 0.04 and 0.05 per cent, respectively; and silicon, 0.15 per cent. Butt welds made with bare electrodes were found generally to be more porous for nickel steel than similar welds made on structural carbon steel. Also, when using bare electrodes the porosity of the weld metal on nickel steel plate was found to be sensitive to arc length and rate of travel. Weld metal deposited from a covered electrode on structural nickel plate did not show the same sensitivity to voltage or speed of travel as with the bare electrode. On structural carbon plates, a covered low-carbon electrode produces a tensile strength of 60,000 to 65,000 lb. per sq.in., whereas the same electrode on ¼-in. structural nickel plate develops 95-100,000 lb. per sq.in., a difference primarily due to the absorption of nickel from the plate metal. However, as the thickness of the plate increases, the alloy content of the weld metal is reduced below that of the plate, lowering the strength of the weld relative to the strength of the plate.

Experience at Watertown Arsenal indicates that a covered electrode is essential to develop sound weld metal and good impact strength. Also, it was apparent from the tests that a suitable coating for an electrode, useful for welding nickel steel, cannot necessarily be similar to that required for electrodes used for welding low-carbon steel. No definite information yet has been developed as to what is a suitable coating. In welding structural nickel steel plate, the heat of welding has a greater effect on the parent metal (producing hardness) than when welding structural carbon steel because of the higher carbon content of nickel steel plate and the presence of nickel. The addition of succeeding layers of metal, if applied sufficiently rapidly to heat up the section around the weld and prevent quick chilling, will, it was shown, reduce this hardness considerably.

None of the present commercial covered electrodes is entirely satisfactory for nickel steel, and a suitable alloy steel electrode is badly needed. An electrode containing 1 per cent molybdenum and covered with a commercial coating has produced good results, according to Mr. Warner.

Welding galvanized steel

Experiments and studies of the welding of galvanized structural members formed the subject of a paper by Leon C. Bibber, senior welding engineer, bureau of construction and repair, Navy Department. Specimens used consisted of plates ⅛ to ½ in. thick. In general, the experiments indicated that the effect of the welding on the galvanizing can be considered negligible and that the effect of galvanizing on the welding is of little practical importance, but that a serious problem exists in protecting the health of welders working on galvanized steel. Detailed conclusions were as follows:

(a) With plating ½ in. thick and thicker, normal welding on one side will not burn off the galvanizing on the other side.

(b) Corrosion resistance of plating from which the galvanizing has been apparently burned off by the heat of welding does not seem to have been lessened in any great degree.

(c) The zinc coating is completely burned off only along a very narrow zone at the toe of the weld; the zinc is melted at a considerable distance from the weld, but the protection of this melted zone is not impaired.

(d) Covered electrodes burn off the zinc to a slightly greater extent than do bare electrodes.

(e) Galvanizing increases the porosity of a single-bead deposit somewhat, but not to as great a degree as might be expected. The increase in porosity is negligible with multiple-bead welds.

(f) Galvanizing decreases the strength of single-bead deposits by a small amount; the strength of multiple-bead deposits seems to be little harmed.

(g) There seems to be little difference in the corrosion resistance of bare and covered electrode welds.

(h) Small single-bead fillets seem to have practically as much resistance to corrosion as the original galvanized plate. Large multiple-bead welds, however, are attacked readily.

Welding versus riveting

Tensile tests of welded and riveted angle members, conducted at West Virginia University, were reported by R. P. Davis and G. P. Boomsliter. Specimens tested included single angles, two angles on the same side of a connecting plate, two angles with a connecting plate between, two angles with two connecting plates and four angles with two connecting plates. Conclusions drawn necessarily were subject to some qualification, but in general they indicated that: in tension members composed of a single angle or two angles on the same side of the connecting plate, the ultimate unit strength, whether welded or riveted, is about two-thirds to three-quarters the unit strength of the parent metal; in tension members composed of two angles on opposite sides of the connecting plate, or of two angles with two connecting plates, or of four angles with two connecting plates, welded joints result in higher ultimate loads in pounds per square inch of net section than do riveted joints; also the elastic limit strength in riveted connections is about 60 per cent of the elastic limit of the steel, and of welded connections is from 75 to 90 per cent of the elastic limit of the steel; in tension members

composed of a single angle or of two angles on the same side of the connecting plate the elastic limit strength of the members is about the same for both welded and riveted connections, namely about one-half the elastic strength of the steel.

Welding cast steel

Structures often require the welding of cast steel to cast steel or cast steel to rolled steel. Charles H. Jennings, of the Westinghouse Research Laboratories, contributed a paper describing an investigation of cast steel welding, which brought out the following:

1. Cast steel can be successfully arc-welded to cast steel or to hot-rolled low-carbon steel, using either bare or fluxed electrodes.

2. Welding is not harmful to cast surfaces, and the results obtained are approximately equal to those obtained with welds made on machined surfaces.

3. The average tensile strength, in lb. per sq.in., obtained from welds made on various combinations of cast and hot-rolled low-carbon steel are as follows:

Combination of Welded Plates	Bare Electrodes	Fluxed Electrodes
Cast to cast	15,800	.....
Cast to hot-rolled	14,000	23,200
Hot-rolled to hot-rolled	16,000	25,000
Cast steel (parent metal)	22,000	.....
Hot-rolled (parent metal)	27,000	.....

4. Ductility as obtained by the free-bend test is for bare electrodes 8 per cent; for fluxed electrodes, 27 to 33 per cent.

5. Fatigue strengths, in lb. per sq.in., were as follows:

Type of Joint	Bare Electrodes	Fluxed Electrodes
Fillet	64,300	75,000
Butt	63,000	73,600

Welding under water

Experimental work in arc-welding under water, conducted at Lehigh University and reported by N. S. Hibshman and C. D. Jensen, indicated not only that good-quality welds are possible on low-carbon steel plate, but that this method of welding is useful in experimental work where it is desired to limit the heat penetration from the weld or to shield the weld from nitrogen and other gases in the air. Covered electrodes give the best results, since they afford a shield for the arc, but they have disadvantages such as the creation of clouds of black smoke in the water or the deposition of a heavy coating of slag that interferes with succeeding beads. Higher current amperages are required to weld under water than in air. Electrode manipulation is more difficult and exacting. W. E. Harvey, in reporting on the metallurgical properties of the welds made under water, pointed out that the grain size of the parent metal adjacent to the welds was considerably less than when welding in air, due to the fact that a large amount of welding heat is dissipated through the water. This small grain size gives the under-water weld increased strength but decreases its ductility over welds made in air.

City Engineers Discuss Important Public Problems

Milwaukee convention of American Society of Municipal Engineers discusses public-works finances, legislation, sewage, air transport, lighting and planning progress

AT THE Milwaukee meeting of the American Society of Municipal Engineers, held Sept. 25, 26 and 27, the board of directors authorized the new president, C. M. Reppert, to sign the NRA engineers' code, which is part of the code sponsored by the Construction League of the United States. A reservation was made that it was signed with the understanding that federal, state and municipal engineers were not affected.

Other action taken included resolutions directed to PWA officials requesting speed of procedure so as to bring projects to early contract. The points made were that more firms of bond attorneys be designated, as the limited number of designated legal firms are so congested with work that new projects cannot hope to get opinions in time to come within the Jan. 1 deadline. Complaint was made that the cost of obtaining opinions had been raised for small projects, with a minimum fee of $500.

It was recommended that steps be taken to make limited amounts of money available for preliminary expenses upon approval of application, leaving the legal procedure to be perfected while preliminaries are being cared for. This would give the cities something with which to meet engineering costs. It was also felt that a campaign of education and publicity should be started immediately to enlist public sentiment for PWA activities. Moving ahead the deadline for receipt of applications from Jan. 1 to April 1, 1934, was requested. It was stated that otherwise the state engineers, PWA, had to have the projects in their hands before Dec. 1. Finally, the state public-works engineers were highly commended for their enthusiastic efforts and unselfish labor, which have already resulted in many approvals. This was held to be particularly valuable in view of the short time available to organize their offices, secure their instructions and study applications.

Greeley Veteran's Award

The society presented the Greeley Veteran's Award for long-time service in single cities to Goline Doremus, deputy chief engineer, Department of Public Affairs, Newark, N. J., who has been in city service since 1906; to W. W. Horner, chief engineer, sewers and paving, St. Louis (in city service since 1905); and to Linn White, chief engineer, South Park Commission, Chicago (in park service since 1904).

Reports were made by chapters from St. Louis, Philadelphia, Chicago and New Orleans indicating curtailed activities due to the effect of the depression on engineers generally. Thomas Buckley for Philadelphia described successful meetings devoted to discussions of the papers that had been printed in the proceedings, especially prepared by the younger members. Prizes are given by this chapter for meritorious service and for essays on engineering subjects.

The board of directors authorized a committee on committees to look over the work of the society with a view to eliminating dead work and encouraging needed improvement in technique.

Revisions in specifications

The society has numerous committees on specifications, which watch developments carefully, make changes in existing specifications to conform to present practice and bring in new specifications if needed. Minor changes only were suggested this year. Some of these changes are as follows: Sidewalk and curb concrete may be made in central mixing plant; tolerance for thickness of concrete pavements is to be obtained by edge measurements. Traffic-marker suggestions were asked. New specifications for cold mixed-in-place bituminous pavements were suggested and changes in the coarse aggregate. A joint study is still under way for pavements in street-railway tracks.

Joint meetings during the convention were outstanding. A joint technical meeting was held with the Wisconsin section of the American Water Works Association, to which the West Shore Water Producers were also invited. Joint luncheons and banquet included ten state and local technical organizations and were addressed by speakers on economic subjects relating directly or indirectly to the PWA and construction generally.

Operation of the PWA

At the luncheon, H. T. Hunt, chief counsel, PWA, who has been with Col. H. M. Waite, deputy administrator, on a tour of the country, explained in detail the planning and control behind the PWA idea, to secure an economic use of material and labor. President

Roosevelt, he said, is the chief engineer of the project and actually looks into and signs all approvals. Concerning wages, he reiterated Colonel Waite's statement of the reason for the high scale to increase purchasing power. The fixing of intermediate scales according to "customary practice" he felt could be worked out on the job in most cases. "Reasonably secured" securities are required because it is the intention to sell them later to normally heavy purchasers of municipals like insurance companies. This is the reason why so much care is taken to get bonds approved by attorneys generally acceptable to bond brokers and investment houses. This statement led to a discussion later, wherein it was said that some of these designated firms of attorneys were so congested with work that opinions could not be obtained in less than 60 days, while other attorneys had materially raised their rates. Mr. Hunt promised to look into this situation with a view toward accepting "opinions" from additional legal firms.

A labor controversy has arisen on the contract of the Milwaukee Sewerage Commission over the employment of union men or veterans. Mr. Hunt said he did not believe that any existing contracts between the contractors and unions would be upset, but on the same day the U.S. district attorney ruled that veterans were to be given the preference in accord with the provisions of the Recovery Act. The matter will doubtless have to be adjusted by the National Labor Board.

Concerning the answering of all questions in Circular 2, Mr. Hunt said he saw no reason for answering those that had no bearing on the application. This was brought out because many applicants have felt that the financial history of a town as to general obligations has no bearing on revenue bond qualifications, since in many cases the revenue bond service has no relation to the tax record. Few, if any, state public-works engineers, however, will accept applications unless all questions, relevant or not, are filled in. Colonel Waite indicated at Chicago that everything was needed for record purposes.

No "lease" contracts have yet been made, said Mr. Hunt, as the President so far has omitted to declare such project-financing operative. In consequence no help can be extended to cities that are without any credit possibilities either through general obligation paper (because in excess of bond limit) or revenue bonds (because of local legal limitations).

No cash advances pending completion of legal procedure can be made for preliminary work, such as engineering, nor even in the case available bonds are "on the shelf," plans completed and contract ready to let, because of limitations imposed by the U.S. Treasury and the controller.

J. L. Ferebee, Wisconsin state engineer, PWA, who had just returned from Washington, described the intricacies of Washington red tape, but indicated that pressure for speed was being applied effectively. C. M. Moderwell, regional advisor, District 3, the Lake States, in a round-table discussion opened by W. W. DeBerard, associate editor, *Engineering News-Record,* outlined the latest organization set-up by slides, one of which showed the "production line" from applicant to final acceptance of bonds and check written. Mr. Moderwell only knew of a comparatively few cases where the last stage had been reached.

John C. Pritchard, chairman of the committee on public utilities, reviewed the operations of PWA. To learn the localities taking advantage of the law's providing for water and sewage utilities, he compiled statistics from *Engineering News-Record* business-news columns. California, Illinois, Louisiana, Michigan, Ohio and Texas showed much activity. The Middle West and Southwest appear most active. State laws hamper action. For instance, Illinois with revenue-bond and sewer-rental laws, has presented some 300 projects for loans, while Missouri, without such laws and where the cities are required to vote general-obligation bonds by a two-thirds majority, has presented less than 25.

Willard T. Chevalier, publishing director, *Engineering News-Record,* in an evening address explained that the consumer-goods revival was due to NRA activities. Production in those industries was down only 20 to 25 per cent, but in the capital-goods field it is still down 80 to 85 per cent. A way must be found, he said, to get capital-goods plants to operating to buy their share of the goods created through stimulation of the consumer-goods industries by the NRA campaign. The public-works program is the government's plan for reviving the production of construction or capital goods.

Newly elected officers are as follows: president, C. M. Reppert; vice-presidents, H. P. Eddy, Jr., Bryson Vallas and George B. Gascoigne; treasurer, H. Shifrin; and executive director, C. W. S. Sammelman, St. Louis.

Technical papers and reports of note related to planning progress, air transportation, lighting, house numbering, street sanitation and a five-year résumé of the operation of the Milwaukee sewage-treatment plant. The following abstracts and notes cover these topics. Two of the technical papers, one reporting on five years of operation of the Milwaukee sewage-treatment plant, the other describing the new city-wide installation of house numbers in Milwaukee, will be given fuller attention in our pages at an early date.

Municipal finance developments

Financial and legislative developments affecting cities during the past year were outlined by Donald C. Stone in the report of the committee on legislation and finance, which also claime the attention of a whole session wit papers dealing with budgeting an financial control, municipal debts an tax delinquencies, the use of public works records and cost procedures, th $3,300,000,000 PWA program, an finally the coordination of engineerin with other aspects of urban develop ment.

Overlapping governing units are re ceiving attention, said Mr. Stone, an sentiment is crystallizing toward simplification. Missouri now permits city managers. Six cities over the country adopted the city manager plan during the past year, bringing the total to 429. Six states (three recently added) now permit county managers, and five counties have them. Revenue charges for sewers are now legal in 26 states, and 400 cities have availed themselves of this method of financing.

Debt limits are the best means of preventing future defaults, said Carl H. Chatters, executive director, Municipal Finance Officers Association, Chicago. Future limitations should take into account economic resources of the community, necessity for the expenditure proposed and the total burden on each parcel of property. Previously only assessed valuation has been considered. Other points made by Mr. Chatters follow: Debts once incurred should be paid in full, but if conditions make this impossible the time should be extended. Tax delinquency is due to well-defined causes and can be reduced by proper distribution of the tax burden, adequate state legislation and intelligent tax administration. State control of local finance is of questionable value but, if exercised, it should be based on cooperation and general legislation.

Street sanitation in Germany

Carl Schneider, New Orleans Department of Public Property, recently spent two months in Germany as a guest of the Oberlaender Trust of the Carl Schuz Memorial Foundation, studying German methods of dealing with street paving, street cleaning and refuse collection and disposal. His observations formed the bulk of the report of the committee on refuse collection and disposal. Why the Germans secure the good results they do, according to Mr. Schneider, is as follows:

"In the first place, one is impressed with the high caliber and ability of the public officials in charge, many of whom hold the degree of Doctor of Engineering. It is also to be said with much emphasis, that the average German workman, municipally employed, is considered the equal if not the superior of those in industrial employment. It is not believed that we can make this same claim for American municipal employees and public officials. The security of position, regardless of political changes, is possibly the foundation on which the whole system rests. The general recognition of the importance

of the work to be done, both by the public and by the men themselves directing the work, may be responsible for better workmanship.

"Secondly, I believe that the climate is one of the important factors, too, in promoting higher standards of cleanliness. Although it was in July that I visited garbage dumps, I came across very few flies. . . .

"Thirdly, long-established customs and habits, both in living conditions at home and in general social behavior, I believe, are reflected to no small degree in street sanitation work. Frugality means less production of refuse and litter; a submerged caste system or its old influences have meant a greater respect for authority, law and order. These matters must be considered at long range—more from the historical standpoint than as the report on a cursory trip and inspection. The United States is still very young, and in due course a more unified national feeling and behavior may supplant many of our obvious faults of today.

"Other factors I shall merely touch upon lightly. Sidewalks are more generally paved the full width, and there were few unpaved streets in the cities I visited. There are few sidewalk trees compared with our more modern American cities. Building construction usually presents a solid front along the street. There are few vacant lots or front lawns to contribute dirt to streets. German cities are cleaner because the people help to keep them so.

"In the paving from property line to property line, and the absence of trees on sidewalks, German cities have eliminated a large amount of natural dirt, which is relatively a larger problem with American cities. . . .

"The climate is conducive to infrequent collections, usually twice a week. Collection expense is also reduced by having all refuse in mixed form; as well as by population density. Dumping is usually inexpensive as a disposal method, and although the hauls are relatively long, the transportation costs are easily offset by the comparatively lower costs for collection. On the other hand, the streets are patrolled more frequently, and as the cleaning is more thorough, more is spent in proportion on street cleaning in Germany than in American cities."

Air transportation

Perry A. Fellows, chairman of the committee on airports, discussed probable and social trends and their effects on the progress and proprietorship of the aviation industry. A synopsis of his 32-page report follows:

Airports and landing fields have been of comparatively recent growth, but their development has been at a remarkably rapid rate. This growth, its character and its prospect of continuance, cannot be accurately gaged without reference to the general social and economic development. The general trend seems to have been toward an increasing degree of public interest in all forms of industry.

Large holders of capital must not be permitted to exploit the field for their selfish ends. Wasteful competition must be ruled out, but beneficial rivalry should be featured. The need for collective bargaining has not yet been seriously felt in the industry. Careful planning is an imperative part of the program.

Under the shelter of the recovery program many benefits should accrue to the air-transportation activities. The increasing part that public interest plays in industry may mean a large degree of social participation in the actual proprietorship in some branches. In view of the fact that few interests in aviation at present outrank those of the people, and with the probability of varying degrees of socialization of industry, the maximum governmental participation should be expected in this field.

Street lighting

Mistaken economy in reducing street-lighting expenditures was indicated by statistics submitted by Ellsworth Francisco, consulting engineer, Newark, N. J., by which he established that decreased expenditures of 19c. per capita in 20 cities, of 42 investigated, increased the cost per capita of night accidents by 69c. These figures are comparisons of 1931 with 1932. In the 22 remaining cities, which increased expenditures 11 per cent, fatal automobile accidents decreased by 25 per cent. The per capita increase was 9c., and the economic saving due to the reduced total of automobile accidents was $2.07 per capita. Mr. Francisco used these statistics as evidence of the necessity of making a close engineering survey of street-lighting systems before cutting budgets unduly.

Planning progress

In a symposium report on planning, Thomas Buckley, Philadelphia, Pa., chairman of the committee on that subject, developed a technique for compiling data and reporting on planning progress to make the successive reports more effectively serve the practical needs of the planner. Excerpts from contributions to the report follow.

Great progress was made in regional planning in this and other countries for several years prior to this unprecedented economic depression, and while regional planning is still very much alive, lack of funds during the past two years has materially interfered with planned progress.

The need for regional planning is due to the increase and dispersion of population, which has been made possible by improvements in transportation and communication.

A recent noteworthy accomplishment in planning has been the recognition by the Federal Emergency Public Works Administration of the need for a planning board to cooperate with it and other planning agencies throughout the country. Also, in the applications for federal funds there is a requirement for the opinion of the planning commissions or associations with respect to the desirability and need for the projects for which funds are requested.

Following business depressions in the past, there has always been a great deal more interest taken in the business of government. There is every reason to believe that history will repeat itself and that very material progress will be made in planning just as soon as it is generally felt that the depression is a thing of the past and that business conditions will soon be normal again.

While state planning has been under way to some degree in several states for a number of years, material progress has been slow, and it is difficult to anticipate what form it will take when it reaches a more advanced and progressive stage. There is a chance that the agitation for county consolidation and the centralization of states may act to retard comprehensive state planning in a number of states.

County planning is carried out officially in 46 counties, out of a total of 3,070 counties in the United States, functioning in 10 states and by 4 unofficial groups representing 4 states.

There are now 808 official city-planning commissions.

Admitting that the ground lost by the city-planning movement during the past year was chiefly due to economic conditions, it must also be acknowledged that in some instances the primary reason might have been the improper approach (too idealistic and lacking in financial practicality) made by the planning commissions to the planning problems of the community.

Progress in the legal status of zoning continues on the firm ground already established. Decisions on zoning cases brought to the attention of the committee during the past year have not added any new qualifications to the legal status of zoning. They have, for the most part, followed similar issues of other years and serve to strengthen the strongly intrenched position that zoning now holds before the low and high courts of the country.

Despite the great amount of thought and energy expended on this subject, little material progress has been made in housing reconstruction. Very encouraging results have been accomplished in certain new developments, and the increasing acknowledgment of the benefits to be derived from large-scale neighborhood planning and building augurs well for the future. While millions have been expended on new housing and re-housing projects in certain classes, the problem of economically housing the lowest-income groups

remains unsolved. Success in this class of improvement, sufficient to provide extensive betterment, seems particularly hopeless in the slum areas of metropolitan districts. High land values in these sections still prevail and make impossible replacements by low-cost housing. Owners and investors must be willing to apply the principle of depreciation to their real estate holdings in slum or blighted areas, so that prices may be reduced to a level whereby the rehabilitation of such districts can become economically possible.

Letters to the Editor

Preserving the Landmarks

Sir—In your issue of Aug. 10, 1933, we find a very interesting and instructive article by Dr. William Bowie, of the U. S. Coast and Geodetic Survey, entitled "Preserve the Landmarks." As one interested in educating the engineers, even the surveyors, and more than ever the layman, in the value of and the limitations of survey monuments, I want to compliment Dr. Bowie for his splendid article, and also you for the space you have given in your paper to this most important subject.

Boundary-line monuments are supposed to last as long as needed or forever, but they do not. Dr. Bowie well explains many of the forces which work to destroy the monuments.

At the meeting of the American Society of Civil Engineers in Chicago in June Dr. Bowie explained a method he has used for protecting the location of a survey corner. The method is to set two monuments, one below the other, the lower monument to be entirely separated from the upper one. This it seems to me is a very important suggestion for monuments. The upper monument could be moved by many causes which would not move the lower one.

W. D. Jones.

Chicago, Ill.
Aug. 16, 1933.

Depleted Storage Reservoirs

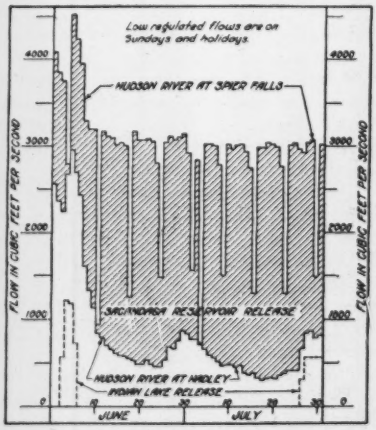
Sir—The sentiments expressed editorially in your issue of Aug. 24 regarding the objections raised by campers to the depletion of storage reservoirs are deeply appreciated.

May I take the liberty of correcting your statement that "The power and paper companies on the Hudson River agreed to reimburse the state for the cost of building and maintaining it (the Sacandaga Reservoir)." The state of New York paid none of the cost of constructing the Sacandaga Reservoir. This work was financed by a $12,000,000 issue of bonds issued by and in the name of the Hudson River Regulating District. All of the fixed and operating costs of the Sacandaga Reservoir, including interest, amortization and maintenance, are obtained from assessments levied against the beneficiaries approximately in the ratio of 95 per cent, collectively, against the benefiting power companies and 5 per cent against the municipalities of Albany, Troy, Rensselaer, Watervliet and Green Island for flood control and sanitary benefits inuring from the maintenance and operation of the reservoir.

The beneficial effect of the Sacandaga Reservoir is strikingly shown on the inclosed hydrograph of the Hudson River at Spier Falls for the months of June and July of this year, covering a drought which in intensity was one of the worst in the known history of the Hudson River. An inspection of this hydrograph will show that for a large part of July, nearly 90 per cent of the flow in the Spier Falls-Glens Falls sector was water released from the Sacandaga Reservoir. During July the average regulated flow at Spier Falls, exclusive of Sundays and the holiday (the gates of the reservoir being closed on these days), was 2,964 sec.-ft., of which 2,446 sec.-ft. was water released from the Sacandaga Reservoir, it being pertinent to note that the average inflow to the reservoir during that month was but 197 sec.-ft.

Incidentally, it may be noted from the hydrograph that the gates of Indian Lake, which is not under the jurisdiction of the Board of Hudson River Regulating District and which you mention in your editorial, were closed from June 6 to July 25 at the insistence of the campers, who, however, have no legal rights on which to predicate any such request.

This condition would have resulted on July 21 in an all-time low flow in the Spier Falls-Glens Falls sector of but 447 c.f.s., whereas actually on that date the regulated flow made possible by the operation of the Sacandaga Reservoir was 3,000 c.f.s.



Hydrograph of the Hudson River at Spier Falls, showing the effect of the Sacandaga Reservoir regulation.

From information which we received from the paper companies located on the banks of the Hudson River below the reservoir, we have learned that over 3,500 employees would have been thrown out of work but for the power made available by the operation of the Sacandaga Reservoir.

Edward H. Sargent,
Chief Engineer,
Board of Hudson River Regulating District.

Albany, N. Y.,
Aug. 26, 1933.

Drainage in Hydraulic-Fill Dams

Sir—In your issue of Aug. 24, E. McD. Moore correctly outlines the essential specifications for an ideal earth dam.

To approach this ideal for dams built by the semi-hydraulic-fill method, he suggests means of draining seepage from the core through the car dump fills in order to secure a higher degree of stability than frequently exists in such structures during the construction period. He also proposes to prevent water from entering the car dump fills by means of a diaphragm of very impervious material. The writer believes that this latter scheme would, with certain fine materials, secure a less stable embankment than if the usual methods were followed.

Under the usual methods of construction most of the material in the car dump fills gets quite thoroughly wetted, and with the deposit of additional material the superimposed loading causes consolidation. If the car dump fills were entirely dry, as Mr. Moore would try to make them, this consolidation would not be nearly as great. If the scheme advocated were followed effectively, it would greatly retard consolidation. Eventually rain would get into the loose fill and consolidation would take place, but this might not be until the dam was in service and slides would then be apt to occur.

Drainage through car dump fills is highly desirable, and Mr. Moore's method of placing fills of sand and gravel at the bottom of the dam across the areas to be occupied by the car dump fills should help materially in securing such drainage. Many semi-hydraulic-fill dams have material in the beach areas (just inside the car dump fills) which is much more pervious than the car dump fills. Consequently, it would seem that provision of the sand and gravel fills, transverse to the axis of the dam, should materially improve drainage conditions and hence stability.

The danger of slides during construction, due to imperfect drainage, is a hazard to which semi-hydraulic-fill dams are much more subject than hydraulic

fill dams. As the writer has previously pointed out in his book, "Earth Dam Projects," hydraulic-fill dams, in which all of the material is transported to the dam by water and distributed and deposited by water, practically always have the coarser material near the faces of the dam. Natural drainage is thus promoted, and as a result such dams are inherently more stable during the construction period.

The semi-hydraulic-fill method of construction is frequently the most convenient and economical that can be adopted in a given case. When the materials available and the conditions under which they are to be used are thoroughly understood, means can be adopted to secure a stable structure during and after construction.

JOEL D. JUSTIN,
Consulting Engineer.

Philadelphia, Pa.,
Sept. 5, 1933.

Timely Advice

Sir—In your editorial on wood borers, in the issue of Aug. 10, you state: "The claim used to be made that a Howe truss would stand up on principle even if the timber had rotted."

About three years ago I had to do with a Howe truss of 70-ft. span, which stood between a roadway and a street railway track and carried one side of each. The bottom chord was made up of three leaves, two of which were pulled apart at the center panel point, while the middle leaf was broken near the far end of the adjacent panel. The only splice consisted of two packing bolts. In speculating on how this truss could stand up, the staff evolved the theory that the force of habit had overcome the force of gravity.

I wonder how many old bridges are approaching such a condition in these days when maintenance has been so badly neglected. Very likely many cities and counties would do well to give their old structures a thorough inspection before it is too late.

ARCHIE M. TRUESDELL.

Gig Harbor, Wash.,
Sept. 11, 1933.

Length-of-Pavement Formula

Sir—In the issue of Aug. 17, J. N. Arnold, of Purdue University, presented a most interesting article concerning the length of road (L) required for one car to overtake and pass another car a certain distance (D).

As Mr. Arnold treats the subject, he assumes a constant speed for each car. In the nomenclature used by Mr. Arnold the formula is

S_2 = speed of slow car
S_1 = speed of fast car

$$L = \frac{D}{1 - \frac{S_2}{S_1}}$$

It would seem that more flexible formulas might be developed, namely:

1. To assume a speed of approach S_0 of the faster car, which accelerates to a speed S_1 to pass, then decelerates to the former speed S_0 after passing, the formula is:

$$L = \frac{D}{1 - \frac{2S_2}{S_0 + S_1}}$$

2. To assume a speed of approach S_0 as before, accelerating to a speed S_1 which is then maintained until the passing car is well cleared of the other, the formula is:

$$L = \frac{D}{1 - \frac{S_2}{S_0 + S_1} - \frac{S_2}{2S_1}}$$

I believe that the last formula is in close agreement with actual driving practice, particularly on two-lane highways.

JAMES A. CONKLIN,
Borough Engineer.

Ramsey, N. J.,
Aug. 21, 1933.

Exit Practices in Buildings

Sir—The article by H. B. Houghton and J. H. Courtney entitled "Survey of Traffic Volumes Through Building Exits" appearing in the *Engineering News-Record*, Aug. 17, p. 200, together with the article by the same authors "Survey of Exit Practices in Buildings" on p. 164 of the Aug. 10 issue, constitute a very valuable contribution to the heretofore meager literature on this subject. As secretary of the National Fire Protection Association's committee on safety to life, which was reorganized as the building exits code committee, American Standards Association, I have been in contact with exit problems for a number of years and feel that intelligent analysis of this subject has been greatly handicapped by the lack of competent engineering data.

In view of the fact that every building must be provided with exits, which in the aggregate represent a major capital expenditure, it is little short of amazing that in the past so few studies have been made of the actual working capacity of exit facilities. The studies by Messrs. Houghton and Courtney present valuable data which I hope may be supplemented by further investigations along the same line. Having had opportunity to review some of the original material on which these articles were based, I feel that while the data presented are of great value, they should be supplemented by additional observations over a wider variety of conditions before being regarded as an engineering basis for exit design.

The flow of persons through stairways, ramps and doorways is not like the flow of water through pipes. In addition to the varied factors of dimension and design, there are highly variable physical and psychological factors. Our committee has attempted on a judgment basis to evaluate the more important of these in its formulas for exits.

At best, this subject must be handled somewhat on a judgment basis, for it seems impossible to make any engineering determination of the behavior of panic-stricken persons in a burning building.

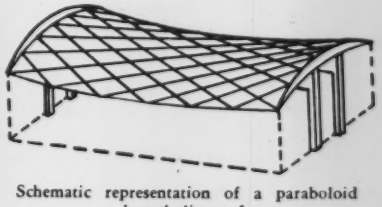
I would direct attention to the possible error in using number of persons discharged per foot of width per minute as a unit of measurement. Our committee has felt that the space occupied be one file of persons, taken at 22 in., is a more logical unit, particularly when considering exits of relatively narrow widths. The author's comment that the rate of discharge is not a continuous straight-line function bears out this thought.

R. S. MOULTON,
Technical Secretary,
National Fire Protection Association.

Boston, Mass.
Sept. 1, 1933.

A Paraboloid Hyperbolic Roof

Sir—A catenary steel-plate roof described in your issue of Aug. 3, 1933, p. 137, is a notable novelty. The computation of the unit stresses and the erection operations involved in a catenary roof are simple. Furthermore, a catenary plate roof provides maximum space within the covered area. A similar problem has been solved by the French engineers with a roof slab suspended from opposite sides and curved to a paraboloid hyperbola (Le Génie Civil, Feb. 25, 1933).



Schematic representation of a paraboloid hyperbolic roof.

A paraboloid hyperbolic roof slab has a high degree of elasticity and easily sustains wind pressures and snow weight. An analysis of the stresses in a parabolic hyperbolic roof slab involves a simple geometrical relation of forces. The slab may be built either of reinforced concrete or welded steel plate. The parabolic hyperbolic slab system has a wide field of application. It may be used in a single unit for covering a large area, as in hangar construction. Likewise it may be used in a multiple-panel roof or bridge deck.

A. A. EREMIN,
Associate Bridge Design Engineer,
State Highway Commission.

Sacramento, Calif.,
Sept. 22, 1933.

Engineering News-Record

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Dividends From Speed

ONE reason for slow progress in getting municipal works projects ready for PWA construction work is the fact that retrenchment has made engineering staffs inadequate. City officials who have not yet built up their engineering organizations or engaged consulting assistants to speed their projects through are in no position to do their part toward putting the recovery fund to work. In addition to speed, however, they have another reason for setting up adequate engineering organizations, namely the fact that thorough preparation pays big dividends in the speed, efficiency and economy of the work itself. Disorganized and decimated engineering staffs are not adapted to the requirement of thoroughness in the necessary degree, a fact that should be recognized by administrative officials in laying out their construction campaign plans. What was done under the dire pressure for retrenchment in government expenditure during the past two years resulted only too often in such reduction of technical staffs that bare routine necessity work had to be handled hastily and superficially and even so was possible only by the devotion and voluntary overwork of the skeleton staff. These inadequate and overworked staffs are quite unable to take on the responsibility of preparing for the emergency construction work of the national recovery campaign and of doing the task justice. The interests of the community as a whole demand, both for most rapid and effective recovery progress and for economy in expenditure, that the technical preparations be carried out by largely increased technical forces. A small sum appropriated for this purpose is certain to return a large profit.

Good Use for Money

PROSPECTS of early financing of the Chicago Sanitary District by the PWA bring hopeful light into a situation that has been dark for years. Both the health needs of the Chicago region and the fight against unemployment argue for early consummation of the proposed financing, for the district is in a position to start a large amount of work quickly on plans well studied and matured for construction, and it is thoroughly well known that the safety of the city's water supply depends on rapid completion of the sewage-treatment system. As to the financial soundness of the district, no question can fairly be raised; its funds are tied up by the freezing of tax collections through obstructive litigation, not by failure to earn adequate returns on investment, so that with the legal muddle well along toward clearing up there is no longer reason to doubt the security of a construction loan to the district. Few better uses could be found for PWA money than financing the Sanitary District and water-filter construction at Chicago. Water filters, unfortunately, are still in the distant future because of an inaction on the part of the city authorities that even the influence of an engineer-mayor has not been able to change.

Wage-Rate Afterthoughts

INTENDED perhaps as nothing more than a strategic move in a controversy with the American Federation of Labor on delay of the public-works program, Secretary Ickes' warning of last week that the PWA construction wage scale may be reconsidered gives proof that the harmful effect of this piece of rate-setting is now recognized at Washington. Until two weeks ago there was no evidence of such recognition; on the contrary the prescribed wage scale was defended through thick and thin as indispensable to the PWA program, and at the same time its reaction on private construction was ignored. The fact is that even the PWA work is handicapped by the scale, as shown by the returns from our state survey (*ENR*, Oct. 5, p. 412), while private construction has found the influence of the scale too severe to enable it to get a fair start. The Ickes statement carries at least a hope that there will be some sober second thinking on the wage question, and that the PWA authorities will consider the problem as broadly and constructively as did the construction-code group.

A Work-Bonus Success

A STRENGTH-BONUS system for paying for concrete construction is described inspiringly in an article in this issue. The principle is that of the wage-bonus system that has been frequently used for paying construction workmen. Both plans are based on the familiar management law of increasing reward with increased performance; value given beyond that contracted for is compensated for. With either a wage-bonus or a quality-bonus system a basis of normal performance is the first essential; the second is that there shall be no chiseling of rewards when they begin to increase. If there is possibility that bonus reward may increase performance to a degree beyond that which is essential or useful to the result of the operation, an upper limit of reward should be set. This virtually was the action taken in the operation described in this issue. As the article particularizes, the outcome was success in getting better concrete at a very moderate cost for extra quality. It illustrates a possibility in specifying engineering construction that has not had deserved consideration in practical application.

Selecting Pumping Equipment

IT IS NOT often that a waterworks problem allows such a wide range of possible solutions as did the choice of the type of pumping equipment to be used in the new Detroit water plant. The analysis of the problem and the conclusions are outlined in an article on another page in this issue. Centrifugal pumps driven by electric motors have become most common in waterworks practice, but in the Detroit case, because of the magnitude of the installation, comprehensive studies were made of the comparative reliability, adaptability and economy of three types of equipment: steam-driven

reciprocating, steam-turbine-driven centrifugal, and electric-motor-driven centrifugal. Tradition and current fashion were therefore largely discounted in arriving at a solution of the problem. As a result of this careful study, motor-driven pumps were selected, with the dependability factor strengthened by the use of power generated at the water plant, lending strong engineering support to the current vogue of that type of equipment.

Constructive Unification

FURTHER simplification of rolled-steel structural sections, which probably will be announced soon, offers a definite gain to the construction industry by saving confusion and duplication of labor. The new simplification lies in adoption of a single list of wide-flange I-sections by the four mills (Saucon and Buffalo of Bethlehem, and Carnegie and Illinois of U. S. Steel) that roll these shapes, in place of the two separate lists now current. Some years ago partial harmonization of the two lists—those of the Bethlehem and the U. S. Steel mills—was brought about, but full agreement on a single standard then seemed impossible. Continuous study of the problem since, coupled with experience and possibly also with the depression's insistent warning against commercial waste, has finally enabled full standardization to be attained. Five depths of section are to be discarded, and all thicknesses, weights, sectional areas and statical properties brought into agreement. The change, when effective, will reduce waste in both production and use of structural steel, a result that will not only raise the economic value of steel construction but also bring profit to the community at large.

Building and Rebuilding

THOSE many conservatives and pessimists who have been exclaiming that we are overbuilt and that we ought to slow up our extravagant community development will find some instructive facts in a recent booklet on the development of Italy, prepared for American information. It shows by brief text and an impressive collection of pictures that an astonishing amount and variety of public improvements has been constructed during the past few years, and that the country has thereby been raised greatly above the level of efficiency and amenity that prevailed ten years ago. One motive for the improvement operations was the need of providing employment for part of Italy's idle labor, but the definite purpose of improving public facilities was a strong contributory influence. Economic and social gain resulted, both through the beneficent effects of production employment and through the creation of a remarkable series of works—a road system that in some respects outstrips our own, reclamation and colonization developments of broad importance, improved railways and airways, new buildings and structures of all kinds. Italy has been largely rebuilt, and a glance at the result suggests that the United States too has a vast amount of building and rebuilding to do. The day when we can rest in satisfaction that the country is fully improved and that more public works would be wasteful is still far in the future. And it needs only a short glance backward to remind us that the savings wasted in unnecessary expansion of industrial plant a few years ago would have produced lasting wealth instead of scrap if invested in public improvements.

Uncle Sam as Santa Claus

IN ORDER THAT the program of the Public Works Administration may be made a success, four major corrective measures are essential, as we pointed out last week. First of these is a drive to complete local programs of needed works that can give immediate employment. This drive has to overcome not only the many administrative difficulties and delays but the all-important handicap of the lack of aggressive and determined will to push the program through. It was such failure of the spirit on the part of Washington officials during the summer that brought about the dillydallying which set the program back nearly three months. But similar failure is found in not a few local governments and their citizenry. It manifests itself in an attitude of dependence. The local communities, forgetting the prime doctrine of self-help, seek to cling to Uncle Sam as the one who must save them by making 100 per cent construction grants for local projects.

Children outgrow their belief in the stork, Santa Claus and other fairy-tale figures by the time they reach the age of twelve. But many city and state officials are less precocious where federal aid is concerned. After paternalistic aid has once been extended to them it seems to weaken their spirit of individualism and independence; and then the new-made clinging vine soon develops into a parasite growth, insidious and strangling in nature. State public-works committees that in recent months labored to get together a program of eligible projects found themselves confronted all too frequently with enthusiasm for 100-per-cent-grant projects but apathy toward the 30-per-cent-grant projects made possible by the Recovery Act!

In a certain few states, where the state authorities early recognized this attitude, public-works committees have struggled to educate local officials to the possibilities and necessities of constructive action to avoid having to continue their unemployed citizens on the dole indefinitely. The federal-aid practice of paying half for roads spread the paternalistic views countrywide, but the West had acquired habits of dependence long before the advent of road largess. It is there that many irrigation federal loans have been all but repudiated. It is there that several more sage-brush projects of the same type, in addition to those already approved, are being enthusiastically fostered. When 30-per-cent municipal projects are spoken of, there is a rather common feeling that the repayment date will be postponed indefinitely.

All over there is hesitation on the part of municipalities to spend even enough money for preliminary engineering to get a fair estimate of cost, and numerous engineers have had to take work on a contingent basis. Let us hope that the day may soon come when officials will regain their efficiency and leave off trying to convert the virile Uncle Sam into a complacent, benevolent Santa Claus. After all, Santa is but the head of the house who has traded for the one night of the year his working clothes for white whiskers and a red tunic while he dispenses the hard-earned fruits of his past endeavors.

If the Santa Claus concept is allowed to prevail, the labors of the Public Works Administration to support recovery through mass employment are foredoomed to failure. Local programs can be completed and pushed through successfully only by courageous participation of all groups and governments in the joint responsibility.

NEWS OF THE WEEK

Illinois Legislature Meets To Consider Public Works

On Oct. 3 the special session of the Illinois General Assembly convened at Springfield, called by Governor Horner to provide funds for unemployment relief and to enact legislation to enable Illinois to take full advantage of the public works act.

The governor desires legislation "to empower municipal corporations and political subdivisions of the state to acquire, construct, operate, improve and extend sewerage systems, sewage disposal systems, drains and other public works, instrumentalities and facilities and to issue revenue bonds therefor, payable solely from the revenues derived from the operation of such works," and also "to empower municipal corporations and political subdivisions of the state to lease, sell or convey real and personal property for the purpose of building public works, in accordance with the National Industrial Recovery Act, and to rent or lease for municipal purposes any such property."

Regulation of Motor Carriers Provided by Washington Law

A comprehensive plan for the regulation of all types of motor carriers is embodied in legislation recently enacted in the state of Washington.

The new regulatory law divides motor carriers into four classes, as follows: Certificated, contract, for-hire and private. Vehicles operated within the corporate limits of any town or municipality are exempted from the law's provisions, as are vehicles engaged exclusively in the transportation of agricultural products from points of production to markets.

"Certificated carrier" is the designation for the common carrier. Operators of such vehicles are required to obtain certificates of public convenience and necessity from the Department of Public Works. They are then subject to regulation in such matters as rates, rules, accounts, service and safety of operations.

A contract hauler is required to obtain permits and to conduct operations under written contracts, copies of which must be filed with the Department of Public Works. These contracts must show all charges and the Department is given power to fix fair and reasonable rates, operating rules, and to prescribe safety requirements.

For-hire carriers are regulated largely in the interests of safety. Private carriers have a permit issued to them as a matter of right when applications are in order.

According to the new law, effective Jan. 1, 1934, buses are to be assessed annually a flat fee of $3 plus $4.50 per seat. Truck and trailer fees are to be increased in amounts ranging from 50 to more than 100 per cent. All these property carriers will pay a flat fee of $3 plus varying amounts based on maximum rated carrying capacity. In addition, certificated carriers, contract haulers and for-hire operators must pay a gross revenue tax.

Correction Note— Maryland PWA Allotments

The Public Works Administration allotments for the state of Maryland were omitted inadvertently from the table published on p. 415 of our issue of Oct. 5. They are as follows: Highways, $3,565,000; other federal construction, $1,950,000; state and municipal projects, $783,000, a total of $6,298,000. While these figures were omitted from the detail statement, they were included in the totals; consequently the totals given are correct.

Minimum Wage Rates Increased on Indiana Highway Work

Wage rates for skilled and unskilled labor on Indiana highways have been increased to a minimum of 55 cents an hour for skilled labor and 47 cents an hour for unskilled. This is about 11 cents an hour over the rate set for last year. Workers are to be limited to a 30-hour week under the provisions of the recovery act.

Commission Orders Building Of Union Station in Los Angeles

Construction of an $8,900,000 union passenger station at the Plaza site in Los Angeles, Calif., has been ordered by the California Railroad Commission, in an order handed down on Oct. 4. Although the order fixes no time for completion of the project, it is assumed that the work will begin at once. A condition of the order is that the city of Los Angeles, in accordance with an agreement with the Southern Pacific, Union Pacific and Santa Fe railroads, shall pay $1,000,000 toward the cost of all grade separations, grading and street paving necessary in the construction of the terminal.

Willamette Valley Sewerage Preliminaries Expedited

Preliminary work is actively progressing in Oregon on the comprehensive system of sewage disposal for Willamette Valley cities. Some 40 cities are concerned in the project, which is to be handled independently by each city. The work contemplated is in accord with recommendations made by the Board of Consulting Engineers appointed by Governor Meier as outlined in *Engineering News-Record*, Sept. 14. Under an appropriation by the State Reconstruction Advisory Board, the consulting board consisting of Ray E. Koon; Chairman, John W. Cunningham and Robert G. Dieck, has been directed to furnish engineering assistance to cities desiring to make applications for loans under the public works act. A number of cities in the valley have availed themselves of the opportunity and the preparation of engineering data for them is under way. Burton E. Palmer, Spalding Bldg., Portland, Oregon, is executive secretary of the State Reconstruction Advisory Board.

Long List of Non-Federal Works Approved by PWA

DURING THE WEEK ending Oct. 7 a total of 77 allotments for non-federal projects was approved by the federal public works administration. Groups of non-federal projects are now being presented to the special board for public works regularly twice a week.

Grants only of 30 per cent of the cost of labor and materials were given to 52 projects, 23 received both grants and loans, and two allotments, to a private corporation, are for loans only. The 77 allotments total $11,976,968.

The private corporation receiving two allotments was the Continental Bridge Company of Florida for building toll bridges, one across Oaklacknee Bay in Franklin-Wakulla Counties and one across Powell's Lake in Bay County. The loan on the first bridge is secured by a first mortgage on the entire structure, with an assignment of a lease by the state road department. The second bridge loan is secured by 5 per cent revenue bonds to be matured serially.

The state of Massachusetts has been allotted $1,400,000 for the construction of a bridge over the Saugus River between Lynn and Revere. Of this total $315,000 is a federal grant, the balance is a loan secured by 4-per-cent general obligation bonds.

Buffalo, New York, has had two allotments approved, one for the sum of $1,198,900 for use in the construction of a new high school building, and one for $1,148,370 for construction of a storm drain. The first allotment carries a grant of $292,000 and the second a grant of $270,000. In both cases the balances are secured by 4-per-cent general obligation bonds.

A loan and grant totaling $3,101,333 has been allotted to Erie County, New York, for the construction and reconstruction of highways and bridges. Of this amount about $54,000 is in the form of a grant, the balance is a loan secured by 4-per-cent general obligation bonds.

Housing and federal projects

In addition to these allotments, approval was given to a tentative allocation of $3,230,000 to the Roosevelt Terrace Housing Development for a low-cost housing project in San Francisco, Calif.

In the field of federal public works, an allotment of $2,800,000 was made for the construction of an annex to the Library of Congress in Washington, D. C. The new building will be five stories high, of fireproof construction.

An allotment of $2,750 was made to the Bureau of Plant Industry for repairs to a sugar plant field station at Canal Point, Fla.

Rules governing prima facie showing

Answering a question raised by the telegraphic survey published by *Engineering News-Record* last week, the 30-day rule

under which tentative allotments are made by the PWA on a prima facie showing of the desirability and eligibility of local projects is proving to be an effective stimulus to the public works program. Local opposition frequently has been overcome when the proponents of a project have been able to show that the money is waiting There is a disposition, however, to expect PWA to take too much for granted. In many cases, the prima facie presentation made by the applicant is not adequate to permit the PWA to authorize even a tentative allotment. There also appears to be a conflict of ideas among the state advisory boards on what a prima facie case demands in the way of preparation. An engineering report is essential, according to the PWA, also a showing that the applicant is able, if a 30 per cent grant is made, to finance the remaining cost either through PWA or otherwise. Applicants should not be deterred by legal complications. These may be referred to PWA for consideration without obtaining a legal opinion in the first instance. If PWA is in doubt after reviewing the facts, the applicant will be advised what course to pursue.

Eligibility of Chicago Sanitary District

Most important development of the past week is Administrator Ickes' announcement of PWA's desire to allot $8,000,000 to the Chicago Sanitary District to complete contracts for sewage works which have been started. PWA is willing to make a 30 per cent grant and take Sanitary District bonds for the remainder if given proof of Chicago's intent to repay the loan. Secretary Ickes made it plain that an allotment cannot be used to pay contractors' claims for past work but explained that if the current investigation by PWA develops that incompleted contracts can be relet, the work will be done under supervision by the federal government and the money allotted month by month as shown to be needed by estimates prepared and certified by federal inspectors and engineers.

As for new work, Secretary Ickes stated that if the Sanitary District will agree and the state legislature now in session will pass the necessary legislation the PWA will make an allotment for work that can be done within the next two years.

The Mississippi Drainage Area board recently appointed by Secretary Ickes with Charles H. Paul, of Dayton, as acting chairman, has organized and hearings have been held on Tri-State Authority flood control project in the Pittsburgh area, Muskingum Valley Conservancy District plans, and Red River Basin improvements.

New housing plans

A federal housing corporation will be set up by PWA to undertake housing construction in communities throughout the country, according to an announcement made on Oct. 10. The amount to be allotted to this work depends upon developments. This action will not interfere with the public works board's policy of making loans to limited dividend private housing corporations.

Secretary Ickes stated, following the public works board meeting, that it has not been definitely decided as yet whether the federal corporation will sell or lease its housing developments, but he considers sale most likely, thereby providing a revolving fund for continuation of the program. The preliminary articles of incorporation of the federal corporation are now being drafted by the public works board. Mr. Ickes stated that he regards housing as the best type of construction the PWA can undertake.

Government contracts speeded

In an effort to expedite federal projects now under consideration, the public works board has adopted a resolution requesting all governmental departments and agencies which have received allotments to limit the period of advertising for bids to the shortest time consistent with good practice. Approximately $400,000,000 in federal contracts have been let to date from allotments to federal agencies from the public works funds, according to H. M. Waite, deputy director of public works.

In response to an inquiry from the Tennessee Valley Authority as to whether the PWA would make an allotment for the construction of Dam No. 3 on the Tennessee River, Secretary Ickes replied that in his opinion the TVA should use its own funds for this work (the TVA has been allotted $50,000,000 from the public works funds). Mr. Ickes stated he believed the TVA funds were ample and adequate for this work, and that PWA funds were needed elsewhere.

The technical board of review is considering New Jersey's applications for $5,000,000 for shore protection.

Eleven allotments to federal agencies were authorized at the Oct. 10 board meeting, chief of which was one for $2,100,000 for construction and repair of National Guard camps. An allotment of $493,229 was made for increased contract expenditures on postoffices now under construction, due to increased construction costs.

The detailed list of the non-federal projects is as follows:

DETAILS OF PWA LOANS AND GRANTS FOR NON-FEDERAL LOANS

Locality	Loan and Grant or Grant	Type	Man-Months Work Provided	Amount
Annapolis, Md	L. & G.	Sewer	5,400	$490,000
Jacksonville, Fla	L. (Private)	Toll Bridge	1,800	403,400
Jacksonville, Fla	L. (Private)	Bridge	1,200	148,087
Richford, Vt	L. & G.	Water Supply	360	80,000
Osceola, Iowa	G.	Water Supply	300	15,810
Marion, Iowa	L. & G.	Sewage Disp. Plant	150	20,000
Norton, Kans	L. & G.	Sewage	180	38,500
Boston, Mass	L. & G.	State Hospital	96	18,000
Bet. Lynn & Revere, Saugus River, Mass.	L. & G.	Bridges and Approaches	3,300	1,400,000
Bernardsville, N. J	L. & G.	Sewer Extension	350	80,000
Princeton, N. J	L. & G.	Incinerator	90	35,000
Republic Co., Kans	G.	County Bridge Repairs	15	1,400
Hillsboro, Wis	G.	Waterworks	20	1,500
Terre Haute, Ind	L. & G.	Add. Street Lights	225	60,000
Boston, Mass	L. & G.	State Hospital	1,125	334,000
Boston, Mass	L. & G.	State Hospital	750	422,000
Hamilton County, Lockland, Ohio	L. & G.	School Building	200	50,000
Alma, Ga	L. & G.	Constr. High School	148	27,100
Honolulu, T. H	G.	Waterworks	2,750	160,000
Newburyport, Mass	G.	Waterworks	320	20,000
Thief River Falls, Minn	G.	Lights and Waterworks	50	15,000
Dallas, Tex	G.	Storm Sewers	4,620	195,000
Colfax Co., Nebr	G.	Gravel Roads and Bridges	160	8,300
Monaca, Pa	G.	Sewer-water	250	13,000
Providence, R. I	G.	Waterworks	4,500	171,000
Wilson, N. C	G.	Municipal Bldg.	60	3,000
Havelock, Iowa	G.	Waterworks	12	1,200
Worth Co., Iowa	G.	Secondary Roads	55	1,800
Oil City, Pa	G.	Street Paving	45	2,500
Baltimore, Md	G.	Sewer	1,300	60,000
Baltimore, Md	G.	Waterworks	963	39,000
Baltimore, Md	G.	Hospitals	2,310	135,000
Baltimore, Md	G.	School Construction	1,995	124,000
Baltimore, Md	G.	St. Repairs and Constr.	1,340	45,000
Mechanicsville, Iowa	G.	Waterworks	16	1,500
Decatur Co., Iowa	G.	Secondary Roads	2,000	23,000
Guthrie Co., Iowa	G.	Secondary Roads	2,555	56,000
Hamilton Co., Iowa	G.	Secondary Roads	285	11,100
Cerro Gordo Co., Iowa	G.	Secondary Roads	21	1,900
Ringsted, Iowa	G.	Waterworks	12	1,400
Wapello Co., Iowa	G.	Secondary Roads	450	22,600
Cerro Gordo Co. Iowa	G.	Storage Bldg.	15	1,500
Algona, Iowa	G.	Waterworks	30	5,100
E. Moline, Ill	G.	Bakery Bldg.	165	8,100
Elgin, Ill	G.	Add. Fac. St. Hospital	480	22,500
Wilmington, Ill	G.	Heating System	216	10,000
St. Charles, Ill	G.	Boiler Inst.	165	7,700
Montpelier, Vt	G.	Water Supply	36	1,120
Gilbert, Minn	G.	Paving	112	10,000
Ottawa Co., Kans	G.	Hwy. Constr.	80	2,680
Everett, Wash	G.	Library Bldg.	300	23,600
Clay Center, Kans	G.	Park Improv.	2,730	8,200
Walla Walla Co., Wash	G.	Road Grading	498	13,500
Newark, N. J	G.	Airport Repairs	150	22,000
Lyon Co., Kans	G.	Co. Hwy. Service	45	2,000
Shenandoah Co., Va	G.	School Bldgs.	480	27,000
Dinwiddie Co., Va	G.	School Bldgs.	45	3,800
Springfield, Mass	G.	Streets Resurfacing	3,650	126,000
Springfield, Mass	G.	Sewers and Drains	3,400	110,000
Lansing, Mich	L. & G.	Street Paving	1,800	170,000
Lansing, Mich	L. & G.	Street Paving	900	101,000
Clarke County, Ga	L. & G.	School Bldg. Road Improv	600	79,665
Macon, Illinois	L. & G.	Water	360	34,000
Hammond, Indiana	L. & G.	Filtration Plant	3,200	700,000
Versailles, Kentucky	L. & G.	Water Supply	510	67,000
Lena, Illinois	L. & G.	Remodel School	360	70,000
Dover, N. H	G.	Water	160	12,600
Medical Lake, Wash	G.	Hospital	200	26,400
Vancouver, Wash	G.	Add. to High School	750	35,000
Battle Ground, Wash	G.	Junior High School	87	6,400
Fort Steilacoom, Wash	G.	Hospital	1,050	70,000
Fort Steilacoom, Wash	G.	Commissary Bldg.	200	6,600
Adams County, Wash	G.	Secondary Road	150	4,400
Columbus, Ohio	G.	Airport Impr.	123	4,400
Erie County, New York	L. & G.	Highways and Bridges	37,208	3,101,333
Buffalo, New York	L. & G.	High School	3,996	1,198,900
Buffalo, New York	L. & G.	Storm Drain	3,600	1,148,370
		TOTAL:	109,629	$11,976,968

Engineers' Code Subject of Hearing By Administrator

THE CODE of fair competition for the engineer's division of the construction industry, submitted to the NRA by the American Society of Civil Engineers as a supplemental code under the construction industry code, was advanced toward formal adoption by a public hearing held in Washington on Oct. 9. Malcolm Pirnie, deputy administrator for the construction industry, presided and Alonzo J. Hammond, president of American Society of Civil Engineers, represented that organization in sponsoring the code.

Formal presentation of the code was made by Carlton Proctor, chairman of the code committee of the Am. Soc. C. E., and amendments proposed by the code committee since the filing of the code to the PWA were outlined by him. Since filing of the code with the NRA, Mr. Proctor stated, the code had been approved by the authorized representatives of the following organizations:

American Society of Mechanical Engineers.
American Institute of Consulting Engineers.
American Association of Engineers.
American Society of Heating and Ventilating Engineers.
American Society of Municipal Engineers.
New York Association of Consulting Engineers.
Structural Engineers Association of California.
Chicago Structural Engineers.
New York State Society of Professional Engineers.
Oregon Technical Council.
Western Society of Engineers.
Connecticut Society of Civil Engineers.
Florida Engineering Society.
Rochester Engineering Society.

In the amendments proposed, the names of these societies were added to the preamble and the five national organizations were specified as being represented in the national control committee set up under the code.

Mr. Proctor, in presenting the amendments, stated that one of the worst effects of the present depression was shopping for engineering services and the price cutting it had brought about in engineering fees, much of which had been done at the expense of employees. He took the opportunity to put the society on record as recognizing the federal government as one of the worst offenders in seeking professional services on a competitive fee basis.

On the matter of wages Mr. Proctor said that the code committee recognized that present standards in many cases were far below actual requirements for mere living needs and that the purpose of the code would not be fulfilled until they were raised to meet the cultural living conditions requisite to professional work.

Wage rates to fulfill this requirement were not set forth in the code, Mr. Practor said, because it had not been found practical to set any one basic group of rates that would be applicable to the whole country. This will have to be done by the regional committees provided for in the code. Even the minimums set forth are acknowledged to be far from requisite. Much the same comment, Mr. Proctor said, applied to fees for engineering services now in the code.

The code committee's proposals for minimum wages and hours were strongly opposed by J. Jay of the Federation of Architects, Engineers, Chemists & Technicians, an organization representing 3,000 employees. As a first step in relieving unemployment among engineers this organization would cut the maximum hours to 30 per week with restricted provisions for emergency work. The minimum wages proposed in the code were declared to be wholly inadequate and the organization does not hold to the view that raising the pay of engineering employees to adequate rates will increase the total cost of construction sufficiently to check new undertakings.

Specifically, the association proposed that the following rates be written in the code: Senior engineers (technical school graduates with 6 years experience, or 10 years of experience for non-graduates) $65 per week; junior engineers (graduates with one year experience, or men with 5 years practical experience) $45; assistants (graduates with no experience) $35; and apprentices $30 per week.

Arnold G. Chapman, president of the New York State Society of Professional Engineers, proposed modifications in the definition of the functions of an engineer, to broaden it and make it more like the definition in the New York State law. On the subject of wage rates, Mr. Chapman proposed $30 a week for engineering assistants rendering the lowest grade of service, to be applicable during the four-month interim in which regional rates are being established under the code.

Article IV of the code should be altered to require the engineer to enter into a contract for all work, eliminating the $1,000 fee minimum now in the code, according to Frank Dougherty, representing the Association of Professional Engineers (Philadelphia), a new organization. Also, Mr. Dougherty said the code should require that engineers supervise all work executed under their contract.

At the close of the hearing Mr. Pirnie stated that the construction industry, in the preparation of its codes, should take cognizance of the fact that increasing costs out of line with income to be expected from new construction will result in postponing new projects until another boom period is upon us; that as a consequence every effort should be made to keep construction costs down in order to stimulate new construction and so "borrow work from a future boom period" to help carry the industry through the present depression.

Wages and hours discussed

Following the hearing, at the suggestion of Administrator Pirnie, representatives of the code committee of the Am. Soc. C.E. sat down with the representatives of the Federation of Architects, Engineers, Chemists & Technicians to determine whether minimum rates and maximum hours of work more acceptable to the employees could be written into the code. The outcome of the discussion was that the employees representatives will endeavor to draw up new classifications for the first three of its four groups, those who may be classed as engineers or as engineering assistants under the code, classifying them by functions rather than experience, and outlining wage rates for each class in the major regions of the country. On the matter of hours, the code committee was unwilling to cut the maximum below 35 hours but agreed to revise the limitations for emergency work to keep the 48 hour provision from being abused.

Special Election Called on California State Water Plan

A special referendum election has been called for Dec. 19 by the Governor of California on the $170,000,000 state water development program. The plan was approved by the legislature last summer, but subsequently referendum petitions were circulated and sufficient signatures secured to require a confirmation by popular vote. The plan as approved by the legislature anticipated PWA financing backed by revenue bonds that would be retired from income from the project, principally the sale of power.

Under normal procedure the question would have waited until the next general election in 1934, but Governor Rolph has made the furthering of the state water plan one of the main features of his administrative program.

Missouri Court Rules Against City Borrowing from PWA

Circuit Judge J. H. Bowron at Salem, Mo., ruled on September 29 that the section of the federal public works act authorizing the lending of money by the Public Works Administration to municipalities which are barred by the state constitution from borrowing is invalid in Missouri. He held that a federal loan obtained under the emergency act is a debt within the meaning of the constitution of Missouri and that no city or town in the state may borrow from the federal government any sum that is in excess of the city's anticipated revenue for one year.

Recently the city of Salem filed an application with the Missouri State Advisory Board of the PWA, for a grant and loan of $40,000 for extensions to the municipal waterworks and light plant. The application was approved and forwarded to Washington for final action on the allotment of funds. An injunction suit was then filed in the Dent County Circuit Court to restrain the city from borrowing the money on the ground that the contemplated debt violated the Missouri Constitution. Counsel for the city at the hearing argued that the loan was not a debt within the meaning of the constitution, since it was proposed to repay the sum out of plant earnings and not by taxation.

In his final ruling Judge Bowron granted the injunction, held that the loan was a debt, that it exceeded the city's revenues for one year, and that such a debt could not be incurred.

G. H. Slawson, mayor of Salem, said the city would appeal to the Missouri Supreme Court, but there is grave doubt that a final decision can be obtained from the higher court before the first of the year.

Hugh Miller, state engineer of the federal Public Works Administration for Missouri, has sent to Governor Park a recommendation that all Missouri state laws inconsistent with the purpose of the NIRA be declared inoperative during the national employment emergency, either by the governor or by the Missouri general assembly. Governor Park is planning to call the general assembly into special session on Oct. 17.

In his letter to the Governor, Mr. Miller directed his attention to an emergency clause in the state constitution under which the state may issue bonds for public works.

St. Paul Devises Means To Encourage Tax Payment

The city of St. Paul, Minn., has recently adopted several measures designed to stimulate the payment of taxes. When contracts are to be awarded, if the low bidder hasn't paid his taxes or assessments he does not get the job or the order for the material.

In the case of petitions for public improvements, the petitioners' names are checked against the records and if it shows any great tendency toward non-payment of real estate taxes or assessments for former improvements, the council refuses to consider the petition.

With the advent of beer, a great many people are asking for beer licenses. Their property is also checked and if the taxes or assessments are delinquent, the applicant does not get his permit.

The city is now checking up on tax-delinquent property which is income producing and is attempting to confiscate rents.

Preliminary Work Progressing Fast at San Gabriel Dam No. 1

Preliminary construction operations on the record-breaking rockfill structure, San Gabriel Dam No. 1, being built by the Los Angeles Flood Control District have reached an advanced stage. The diversion tunnel is driven and almost lined, the streambed is excavated to rock and about 50,000 cu.yd. of material has been stripped from the main quarry site. After final approval of streambed rock by consultants and the state, work will be started on the concrete gravity toe dam and the rockfill. These operations are scheduled to start within two months.

The 30-ft. diameter diversion tunnel through the east abutment now lacks only a short section of concrete lining to be ready for the coming season of runoff. A separate aggregate and concrete plant was set up for lining. Mixed concrete is taken into the tunnel by train and placed either directly in the invert section or handled by gun for the side walls and arch. The reinforced lining is 2 ft. thick. Near the upstream portal a gravel fill diversion dam with a timber face has been completed.

Shovel and truck operations have removed the streambed deposit to rock over most of the damsite area. This exposed rock is now being washed in preparation for a final geological inspection. Along the upstream toe deep grout holes are being drilled although the cutoff trench excavation has not yet been started. The cutoff will connect with a gravity section concrete toe dam.

The east abutment has been sluiced of loose material and will receive final trimming as the rockfill is raised. On the west abutment power shovels and trucks were used to strip the loose overburden and this work has now been stopped and will be resumed later.

At the main quarry site, immediately downstream from the damsite, about 500,000 cu.yd. of stripping has been removed out of the original estimate of 1,000,000 cu.yd. This material is being trucked into a nearby canyon. It cannot be overcast into the streambed as this area is within the flow line of the Pine Canyon reservoir now under construction by Pasadena. It is estimated that the quarry will be ready by the time the site has been approved and the toe dam advanced enough to begin the fill.

Labor Classified on Dredging To Be Done with PWA Funds

In order to aid contractors in the setting of minimum wage rates on dredging work to be carried out in the Jacksonville area in Florida, Major B. C. Dunn, district engineer, has set up classifications for skilled, semi-skilled and unskilled labor. The classifications are subject to being overruled by the labor board of the NRA. Late in August the public works board of the NRA set minimum rates for skilled and unskilled labor which for the Southern zone are $1.00 an hour for skilled labor and 40 cents an hour for unskilled.

In the skilled labor class the district engineer at Jacksonville places chief enginemen, chief electricians, dredge runner, drill runner, drill dresser, powderman, leverman, blacksmith, machinist, rigger, carpenter, and cranesman. Assistant enginemen are put in the unskilled class, also assistant electricians, fireman, quartermaster, steersman, drag tender, oiler, ship keeper, boatswain, machinist's helper, carpenters' helpers, launchmen and handyman. Unskilled labor includes: deckhand, dredgehand, stoker, wiper, shoreman, linesman, boatman, dumpman, axman, dishwashers, derrickhand and scowman. Cooks, cooks' helpers and waiters are exempt from the 30-hour week limitation as belonging to the administrative class. Masters, mates, chief engineers or chief enginemen and their assistants, electricians, clerks on record work, civil engineers and other employees in professional and technical grades, inspectors, foremen, stewards and quartermasters in charge of supplies also are considered as being outside of the 30-hour week limitation.

Colorado Specifies Wages To Be Paid on Public Works

The Colorado industrial commission has specified the wages to be paid under the public works program in that state. The figures named represent a minimum wage scale on all contracts of more than $5,000. For Denver, Pueblo and Colorado Springs, and within a 15-mile radius of those cities, the scale is as follows: skilled labor, $1.25 an hour; semi-skilled labor, 80 cents; unskilled labor, 62½ cents. For the rest of the state: skilled labor, $1.10; semi-skilled labor, 75 cents; unskilled labor, 60 cents. All wages are based on a maximum working week of 30 hours. However, these wages do not apply to contracts already let.

NEW RAILROAD FACILITIES FOR HAMILTON, ONTARIO

Placing in service of the new passenger station in Hamilton, Ont., marks the complete modernization of the Toronto, Hamilton & Buffalo Railroad Co.'s facilities in that city. Included among the improvements are extensive track elevation and grade separation work involving a number of vehicular and pedestrian subways. These structures, designed for Cooper's E-70 loading, consist of a steel superstructure with concrete abutments and intermediate steel columns on concrete footings. Some 3,700 tons of structural steel, 40,000 cu.yd. of concrete, and 160,000 cu.yd. of excavation and fill were required for the work.

The new station is a combination railway terminal and office building, and provides accommodations for both the railway executive and operating staffs. A 7-story tower with two-story wings on either side make up the building, which has a structural steel frame. The enclosure is limestone, in large slabs. The building is distinguished structurally by the absence of corner columns in the tower. Railroad tracks adjoin the station on the rear, at the second story or concourse mezzanine level. Baggage and express facilities are provided beneath the tracks.

The project was carried out under the supervision of H. P. Malcolmson, vice-president and general manager, and R. L. Latham, chief engineer of the T. H. & B. Railway Co. Fellheimer & Wagner, New York City, were the architects.

Denver Water Department Goes Through Reorganization

Important changes in organization and personnel have been made by the Denver water department as the result of the recommendations made by E. G. Plowman, the city's recently employed efficiency expert. All executives' salaries were cut 10 per cent, and other employees' salaries cut 5 per cent.

In the readjustment, C. C. Schrepferman, who was general manager, becomes manager of construction. J. C. Sweeney, who was superintendent of the entire system, becomes an assistant to Mr. Plowman. H. C. Maloney, who was superintendent of service, also becomes an assistant to Mr. Plowman. C. R. Geisel, who was assistant to Mr. Sweeney, becomes acting city superintendent. George F. Hughes, who was secretary of the water board, becomes office manager.

All employees go on a 5-day-week basis.

Norris Dam to be Built Lower than First Plan

The Norris Dam, to be built on the Clinch River near Knoxville, Tenn., as part of the Tennessee River system development, will be about 14 ft. lower than originally planned. This decision was reached at a meeting of the three directors of the Tennessee Valley Authority at Knoxville with John L. Savage of the United States Reclamation Bureau, under whose direction plans for the Norris Dam are being completed.

"Our decision, in general, is to build the dam about 14 ft. lower than the original plans and to build it somewhat thicker, especially in the upper part," said Chairman Morgan at the conclusion of the conference, adding: "The height adopted for the dam will make possible the full use of the stream flow for power, except during exceptionally wet years, and it will also provide for flood control and navigation."

Original War Department plans called for a dam rising 250 ft. from bedrock, 185 ft. wide at the base and an overall crest length of 2,009 ft.

Brief News

A PROPOSAL TO CONSTRUCT a sewage Disposal plant at Elkhart, Ind., costing nearly $850,000, has been voted down by the city council.

CONTRACT FOR THE CONSTRUCTION of the Pine Canyon Dam conduit was awarded recently to the Consolidated Steel Corp., Ltd., for $654,972 by the Pasadena Water Department. The conduit will be of welded steel, 30 in. in diameter, 8.5 miles long.

HARRY D. WILLIAR, JR., Chief Engineer of the Maryland State Roads Commission, reports that the recent storm which swept along the coast did damage amounting to $406,850 to Maryland highways. About $50,000 was expended immediately after the storm for emergency repairs.

LONG BEACH, CALIF., voters have approved a proposed $4,930,000 bond issue to be used for the reconstruction of schools damaged by the earthquake of March 10. The proposal to issue the bonds was carried by a decisive vote. The total will be divided as follows: elementary schools, $3,000,000; high schools, $1,830,000; junior college, $100,000.

GOVERNOR MURRAY of Oklahoma has announced that he will follow the judgment and wishes of counties, cities, towns and independent school districts throughout the state on projects to come under the federal public works program, but he has warned the subdivisions against bond issues which would exceed the constitutional tax limit.

BIDS TOTALLING $2,464,000 as compared with the engineers' estimate of $2,776,672 for the Grand Island bridges at Buffalo, N. Y., have been received by Frederick Stuart Greene, superintendent of public works. The bridges are to be built by the Niagara Frontier Bridge Authority with R.F.C. funds. It is expected that construction will be under way early in October.

USE OF THE NEW UNION TERMINAL in Cleveland by all the railroads entering Cleveland is being studied by Joseph B. Eastman, federal coordinator of the railroads. At the present time, the New Central, which controls the terminal, the Big Four and the Nickel Plate, use the terminal. Then Pennsylvania, the Baltimore & Ohio, the Wheeling & Lake Erie, and Erie still use outside terminals.

FINANCIAL ARRANGEMENTS having been completed, the Cie. National du Rhone is to proceed immediately with the development of power projects and the construction of power lines from the Lyons region to Marseilles and Paris. Navigation work and the equipment of port facilities at Lyons, and at other places on the coast to the south of Lyons, will proceed concurrently and subsequently to the carrying out of the power project.

SOCIETY CALENDAR

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, annual meeting, Chicago, Oct. 17-21.

HIGHWAY RESEARCH BOARD, National Research Council, Washington, D. C., Dec. 7-8.

NATIONAL CONFERENCE ON LOW-COST HOUSING, sponsored by the Cleveland Engineering Society, is to be held in Cleveland Oct. 25-27.

NEW YORK STATE SEWAGE WORKS ASSOCIATION will hold its fall meeting at White Plains on Oct. 27 and 28.

NORTH CAROLINA SECTION, American Water Works Association, and the NORTH CAROLINA SEWAGE WORKS ASSOCIATION will hold a joint annual convention at Statesville, Nov. 13-15.

ROCKY MOUNTAIN SECTION, American Water Works Association, will hold its annual meeting at Denver, Colo., Oct. 24-26.

WISCONSIN SECTION, American Water Works Association, Sept. 25 and 26 at its Milwaukee meeting elected L. F. Warrick, state sanitary engineer, Madison, president. A. H. Miller was chosen vice-president and C. P. Gross, new director. L. A. Smith, Madison, is secretary-treasurer.

MISSOURI WATER AND SEWERAGE CONFERENCE held its ninth annual meeting Sept. 22 and 23 at Jefferson City. Five papers and a round-table discussion made up the program. Some of the subjects were as follows: Water softening trends and costs, experiments on odor abatement in open seswers with hypochlorite, PWA, operation of Springfield's four sewage plants. The following officers were elected: chairman, L. P. Andrews; vice-chairman, Hugh Brown, and secretary-treasurer, Herbert Bosch, Jefferson City. Representatives on the board of control of the Federation of Sewage Works Association, Ralph Fuhrman, and E. S. Glenn.

Personal Notes

LEONARD A. DAY, former water commissioner for St. Louis, Mo., has opened an engineering office in that city. He plans to specialize in municipal and industrial water supply work.

ROSS WHITE, of Pasadena, Calif., has been appointed by the Tennessee Valley Authority to serve as construction superintendent of the Norris Dam. He has recently been construction engineer for the Pine Canyon Dam at Pasadena.

ALBERT W. THOMPSON, for the past nine years engineer of the town of Norwood, Mass., has received a temporary appointment as town manager, succeeding P. J. Feeney. Mr. Thompson will continue to head the engineering department.

M. DWIGHT BELL, EDWARD P. BURCH, RUSSELL H. BENNETT, HAROLD E. McWETHY, ADOLPH F. MEYER and WALTER H. WHEELER, six consulting engineers of Minneapolis, Minn., have organized a group which will be known as the "Associated Consulting Engineers."

JOHN D. WALDROP has been appointed state highway engineer of North Carolina. Mr. Waldrop has been continuously with the North Carolina state highway commission since 1917. He was for two years previously in his present position. He also has been chief construction engineer of the state highway department.

W. W. HORNER, for many years sewer and paving engineer for St. Louis, Mo., announces the opening of a consulting office in St. Louis. Mr. Horner will continue to serve St. Louis in a consulting capacity as he has Dallas, Tex., for some time. He was recently appointed to the Board of Technical Review, PWA. H. Shifrin, former assistant chief engineer, sewers and paving, St. Louis, is associated with Mr. Horner.

L. R. AMES has been forced to resign as state highway engineer of North Carolina by the state highway commission. No charges were preferred against Mr. Ames and no reasons why he was ousted have been made public. Mr. Ames has long been connected with the North Carolina state highway commission, having served as chief engineer under previous administrations as well as the present one.

WILLIAM M. SPANN of Kansas City, Mo., has been selected to serve as engineer examiner in the office of Col. Hugh Miller, state engineer in Missouri for the National Public Works Administration. From 1922 to 1926 Mr. Spann was chief engineer of construction for the Missouri State Highway Department. In 1927 and 1928 he served as city engineer for St. Joseph, Mo., and since 1928 has been chief engineer of the Jackson County Highway Department.

MONTGOMERY B. CASE has joined the organization of Modjeski, Masters & Chase, consulting engineers. He will make his headquarters at the Philadelphia office of the firm, taking the place of Clement E. Chase, who was killed recently in a fall while inspecting the Philadelphia-Camden bridge. Mr. Case, most recently engineer of construction for the Port of New York Authority on the George Washington suspension bridge, the Bayonne arch and other

structures, was also senior resident engineer in charge of construction of the Philadelphia-Camden bridge from 1923 to 1926. Mr. Case started to work for Ralph Modjeski in 1906 as an instrument man and inspector on bridges being built at Vancouver, Wash. Later, also for Mr. Modjeski, he was engineer of construction on the Celio bridge over the Columbia River for the Oregon Trunk Railway, for the Cherry St. concrete arch at Toledo and for the Harahan bridge at Memphis, Tenn.

Obituary

W. L. CRANE, for 22 years town engineer of Fort Garry, Man., died recently at that place at the age of 63.

RICHARD MELVILLE, contractor, for many years head of the Richard Melville Construction Co., Brooklyn, N. Y., died recently at the age of 61. Mr. Melville retired from the construction business four and a half years ago.

D. G. MUNRO, president of the General Construction Co. of Spokane, Wash., died recently in that city. Mr. Munro was a pioneer railroad contractor, having brought both the Union Pacific and the Milwaukee roads into Spokane. During the past year, he became affiliated with G. D. Lyon, under the name of Lyon & Munro.

FRANK LEE MEEHAN, one of the best known jetty and bulkhead engineers in the Long Island, N. Y., area, died on October 1 after a lengthy illness. He was 74 years of age.

DONALD FERGUSON, a prominent contractor at Newton, Mass., died in that city city Oct. 1 at the age of sixty-nine. He was a native of Mira, Cape Breton, and had been in the general contracting business for forty-five years.

ALBERT M. AMMIDOWN, an engineer associated with the firm of Densmore, Le Clear & Robbins, Boston, Mass., in the construction of various large Boston buildings, died in that city on Sept. 28. He was born at Roslindale, Mass., fifty-nine years ago.

RICHARD W. DROWN, JR., formerly a contracting engineer in Lynn, Mass., and lately president of the Equipment Sales Company of that city, died from a self-inflicted bullet wound on Sept. 28. He was born in Lynn in 1879 and was educated at the Harvard Engineering School.

WILLIAM MONCURE, a civil engineer who was for a long time connected with the Seaboard Air Line Railway, died Aug. 23 at his home in Richmond, Va. Mr. Moncure had a record of nearly 50 years service with the Seaboard Air Line Railway System or its predecessor lines, as chief engineer of certain portions of the system and superintendent of certain divisions. He was 82 years old.

Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Average Four Weeks Oct., 1932	Week Oct. 12, 1933
Federal Government	$6,263	$13,334	$17,510
State and municipal	13,700	12,929	5,612
Total Public	$19,963	$26,263	$23,122
Total private	5,240	8,684	5,167
Week's total	$25,203	$34,947	$28,289
Cumulative to date:			
1932		$965,100	
1933		744,631	

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Week Oct. 12, 1933	Cumulative, 1933
Public:		
State and municipal issues	$8,186	$226,227
PWA loans and grants	12,277	603,787
Total public	$20,463	$830,014
Private:		
Corporate issues	.....	$46,347
PWA loans	$3,230	41,434
Total private	$3,230	$87,781
Total private and public	$23,693	$917,797
Cumulative, 1932		$592,500

Note—These new capital figures include all private bond and stock issues sold for new productive purposes; all state and municipal bonds sold for construction purposes; all R.F.C. advances made on previous commitments on self-liquidating loans; and loans and grants made by the Public Works Authority to states, municipalities and private corporations for new construction work, including the special highway fund, but excluding all federal allotments from the PWA fund for federal projects that would ordinarily be financed by regular federal appropriations.

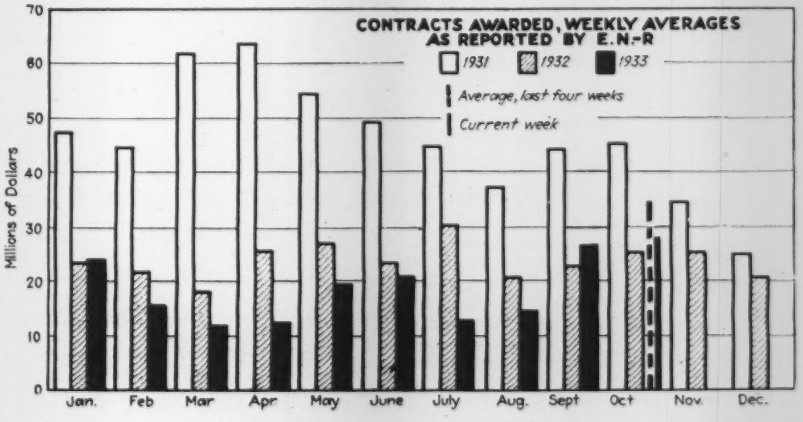
ENR Cost and Volume Index

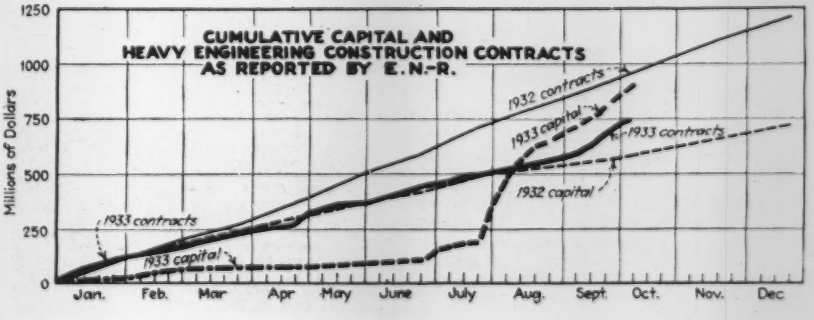
E.N.R.-Cost		E.N.R.-Volume	
October, 1933	**187.74**	**September, 1933**	**122**
September, 1933	175.48	August, 1933	73
October, 1932	159.16	September, 1932	124
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 (Average)	100		

Engineering Contracts and Capital

FEDERAL government contracts awarded last week accounted for 62 per cent of the total of all heavy engineering construction contracts reported. The week's total was $28,289,000, of which $17,510,000 was for federal work. While the week's figures indicate a considerable loss from the previous week's total of $39,604,000 they are not strictly comparable, because a printing schedule to meet Columbus Day holiday forced the closing of these pages one day earlier than usual, cutting out a full day's contract reports. State and municipal awards were the lowest in two months, amounting to only $5,612,000. Private contracts also fell off from the average of the past few weeks, the total being $5,167,000. A single award for a chemical plant at Wilmington, N. C., accounted for more than half of the private total. Most of the federal work was for river and harbor improvements. Following close upon the allotment from the public works funds for upper Mississippi River improvements, the War department let contracts for three dams at Canton, Mo., Alma, Wis. and Minneiski, Minn., all costing about $2,000,000 each. Contract was let for jetties in Brazos Island Harbor, Texas, amounting to $2,600,000. A breakwater at Chicago, $1,574,000, and dredging of the Mississippi near its mouth, $1,467,000, were among the large federal awards of the week. Highway lettings fell off to $5,908,000 after being above 10 millions for several weeks. California and Missouri each let road contracts in excess of a million dollars.

New productive capital reported for the week totals $23,693,000, of which $15,507,000 was in federal grants and loans from the public works funds. State and municipal bond sales totalled $8,186,000. An issue of $7,500,000 highway bonds sold by Louisiana accounted for most of the state and municipal financing. The PWA allotted $3,230,000 for private housing projects.



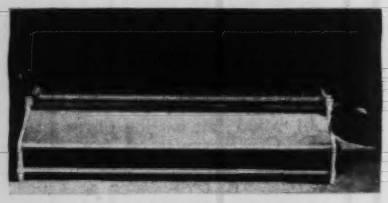


Construction Equipment and Materials

Compact Developing Unit For Black-and-White Prints

A compact and inexpensive developing unit for making black-and-white positive prints directly from tracings, without the use of a negative, has been announced by the Charles Bruning Co., New York City. The new unit is designated as No. 2836 motor-driven BW machine.

This machine develops prints up to 36 in. in width. In making a black-and-white



New machine develops black-and-white prints after exposure of tracing.

positive print from a tracing, the tracing is first exposed with the BW paper in the blue printing machine, exactly as in making a blue print. The exposed paper is then introduced into the BW developing machine, from which it emerges fully developed. No washing of the print is necessary.

General Demolition Hammer Developed by Keystone

A 300-lb. hammer, mainly intended for general demolition purposes, designed to be attached to a power shovel, has been developed by the Keystone Driller Co., Beaver Falls, Pa. The hammer head has a removable striking face which may be of any desired shape, such as flat, convex, cancave or semi-spherical, or, for special applications, an axe, pick, mattock, or fork-shaped tool may be provided.

The hammer weighs 3,000 lb. and is capable of delivering 20 blows per minute; the drop is from 5 to 10 ft. A sharp pull on the hauling line at the beginning of the drop greatly augments the striking force, giving this hammer a much greater effectiveness for its size than a simple gravity tool. The hammer head is rigidly attached to a tubular handle about 8 ft. long, which is hinged to the boom end. The method of attachment is somewhat similar to that employed on the Keystone pullscoop.

Among the more obvious of the applications listed by the maker are the following: breaking reinforced concrete pavement; breaking ice or frozen earth crust, demolishing small structures; fences, walls, and parapets; breaking castings in scrap yards, foundries and steel plants; breaking shale and sandstone bodies which are too hard to dig and would otherwise have to be blasted; breaking oversize rock and other obstructions encountered in excavations, or to be used on layer compacted fills; tamping, driving short piles and fence posts.

300-lb. hammer attached to power shovel.

New Publications

Blowers. Bulletin 21-B16, illustrating and describing Victor-Acme blowers, has just been published by Roots-Connersville-Wilbraham, Connersville, Ind. The Victor-Acme line includes a complete range of blowers in the smaller capacities, up to 7 lb. pressure, or equivalent vacuums.

Steel Stock List. Joseph T. Ryerson & Son, Inc., Chicago, Ill., have just published a larger and much more complete Stock List than any of their previous issues. The new books run over 200 pages and include compete information and data on practically every kind of steel that is made, including all special grades of cold finished steels, alloy steels, stainless steels, etc., also brass, copper and other non-ferrous metals.

Valves. Catalog No. 23, consisting of 264 pages of information on valves and valve layouts, has just been published by Jenkins Bros., 80 White St., New York, N. Y. Full information is given about the metals used in making the valves. Services, pressures, temperatures and fluids for which the valves are recommended are stated. The last section of the book contains many pages of engineering data that are constantly needed where valves are used.

Business Notes

D. W. HAERING & Co., INC., Chicago, water consultants and manufacturers of H-O-H water treatments, announce opening of their New York office at 1451 Broadway, New York City, and the appointment of William Wright as district manager.

CHASE BRASS & COPPER Co., Waterbury, Conn., has acquired the assets of the Erskine Copper Radiator Corp., for whom it has been manufacturing equipment for several years, and will now handle not only its manufacturing but sales as well. For this purpose a new department has been established under the name of "Chase Brass & Copper Company—Erskine Radiator Division." James B. Erskine, who has been president of the Erskine Co., will join the Chase organization and take charge of the sales of the Erskine Division in the East.

New Equipment in Brief

Air-Cooled Engine. An air-cooled engine for the compressor, truck, tractor and general industrial field, has been announced by Doman & Marks, automotive engineers, 101 Court St., Syracuse, N. Y. It is a 6-cylinder engine, with a 4-in. bore and a 5-in. stroke, developing 104 hp. at 2,600 r.p.m. The cooling air is supplied by a centrifugal blower mounted on the crankshaft.

Diesel Engines. The Hercules Motors Corp., Canton, Ohio, have developed a 6-cylinder solid-injection, high-compression, full diesel engine for automotive, general industrial, agricultural, oil field and marine purposes. This engine is to be known as their Model DXI, and is constructed to operate at speeds up to 2,000 r.p.m. The engine will develop from 100 hp. at 1,000 r.p.m. to 188 hp. at 2,000 r.p.m.

Nozzles. A new spray nozzle has been announced by the Chain Belt Co., Milwaukee, Wis., especially designed to be used for cleaning purposes. The maker states that a low water consumption is obtained by the design of the nozzle, in which a round stream hits a curved deflector plate with retaining sides. The result is a flat spray, free from mist, with all the water powerfully directed toward the material to be cleaned.

Tractors. The Sterling Tractor Equipment Co, Brooklyn, N. Y., announces the Sterling Tiger tractor, model C, built with either three or four wheels and with either tiller-bar or wheel steer. The four-wheel tractor will turn in a radius of 86 in.; the three-wheel tractor requires only 78 in. The tractor has an overall length of but 78 in., a width of 43 in. and a height of 51 in. It weighs about 2,900 lb. and has a drawbar pull of 2,000 lb. It is equipped with solid rubber tires.

Protective Coating. A new type of protective coating known as Rustarest, used either alone or in combination with red lead, has been announced by the Inland Products Co., Detroit, Mich. The manufacturer states that the material penetrates the pores of the metal, excluding all moisture and air and protecting the metal against chemical or electrochemical action. It is stated that it is necessary to use only 8 lb. of red lead per gallon of mixture to provide the necessary coloring matter.

Grade-ometer. The Austin Grade-ometer is a newly developed precision instrument to be used with a road grader. It indicates the lateral angle of the graded surface. It consists of a U-shaped glass tube partly filled with a red fluid, only one-half of the tube being exposed to view. When the grader blade is in a level position, the indicator registers zero. It is made by the Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago, Ill.

Welding Clamp. Oster-Williams, Cleveland, Ohio, manufacturers of threading equipment, have announced a new type welding clamp known as the "Bull Dog." It is made at present in two size ranges, one from 4 to 6 in., and the other from 8 to 12 in. One lever controls the action of the clamp. It automatically centers the two lengths of pipe to be welded and adjustable screw faces keep them the correct distance apart for efficient welding. The smaller tool weighs 18 lb. and the larger one weighs 26 lb.